

City of Peterborough

Fire Station No. 2

100 Marina Boulevard, Peterborough, Ontario

City of Peterborough RFT No. 22-100789



Lett Architects Inc.

138 Simcoe Street

Peterborough, ON K9H 2H5

705.743.3311 lett.ca

Design for the Human Spirit

Specifications

Project No. 21-100

Date of Issue: August 17, 2022

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AMR Engineering
Structural Consultants

Durham Energy Specialists
Mechanical & Electrical Consultants

Engage Engineering Ltd.
Civil Consultants

Basterfield and Associates
Landscape Consultant

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END OF SECTION

- 1 GENERAL
 - .1 Information on existing conditions made available to bidders under this section, is included in the Bid Documents for information purposes.
 - .2 The Owner and Consultant assume no responsibility for the scope and accuracy of the information contained in the documents listed herein.
 - .3 The Contractor and all Subcontractors shall be responsible for conducting an on-site evaluation of conditions which can be observed and for correlation of these conditions with the information included under this section.
 - .4 Information contained in documents listed here may be used by the Contractor and/or Subcontractor to assist in an assessment of existing conditions. Evaluation of the information shall remain the responsibility of the Contractor and all Subcontractors.
- 2 DRAWINGS
 - .1 A Topographic Survey of the Site was carried out for the Owner by A.R. Wakeling Surveying Services, and is appended to the Bid Documents:
- 3 REPORTS
 - .1 A Geotechnical Investigation of the site was carried out for the Owner by Cambium Inc. Refer to the following document appended to the Bid Documents:
 - .1 Geotechnical Investigation Report Fire Station #2
100 Marina Blvd.
Peterborough, Ontario
Ref # 13544-003
November 5, 2021
 - .2 An Environmental Impact Study of the site was carried out for the Owner by Cambium Inc. Refer to the following document appended to the Bid Documents:
 - .1 Scoped Environmental Impact Study at
100 Marina Blvd.
City of Peterborough, Ontario
Ref # 13544-002
January 12, 2022
 - .3 A Noise Impact Study of the site was carried out for the Owner by Cambium Inc. Refer to the following document appended to the Bid Documents:
 - .1 Noise Impact Study
100 Marina Blvd.
Peterborough
Ref # 13544-004
January 14, 2022

- .4 An Archaeological Assessment of the site was carried out for the Owner by Northeastern Archaeological Associates Ltd. Refer to the following document appended to the Bid Documents:
 - .1 Stage 1 and 2 Archaeological Assessment of
100 Marina Boulevard, Part Lot 17, Concession 2
Geographic Township of Smith, Peterborough County
City of Peterborough, Ontario
Ref # P025-0711-2021
October 15, 2021

END OF SECTION

- 1 SUMMARY OF WORK
 - .1 Work under this Contract covers the construction of a new Fire Station No 2 on Marina Boulevard in Peterborough Ontario.

- 2 WORK RESTRICTIONS
 - .1 Contractor's Use Of Site
 - .1 Use of site is limited to areas indicated on the drawings. Areas designated for storage of material and equipment (Marshaling Areas) shall be designated by the Owner.
 - .2 Do not unreasonably encumber site with materials or equipment.
 - .3 Obtain and pay for use of off-site additional storage, or work areas as required by the Work.

 - .2 Hours of Work
 - .1 Hours of work for this contract are generally confined to regular daily business hours of 7am to 6pm Monday to Friday. Where required by sequencing of the Work, or where shutdown of building services is required, portions of the Work may be required to be performed outside of regular daily business hours, or on weekends, at no additional cost to the Owner.

- 3 OFF-SITE WORK
 - .1 The Contractor is responsible for the following work:
 - .1 Municipal Sidewalks and Asphalt Paving: Repair and make good all concrete sidewalks, curbs and gutters, and all asphalt paving where disturbed by the Work of this Contract. All repair and replacement work shall be to local Regional and Municipal standards.

- 4 SERVICES AND UTILITY SYSTEMS
 - .1 Consult with utility companies and other authorities having jurisdiction to ascertain the locations of existing services on or adjacent to site.

 - .2 Information as to the location of existing services, if shown on the Drawings, does not relieve the Contractor of his responsibility to determine the exact type, number and location of existing services.

 - .3 Maintain all utility systems affected by work of this Contract, until the building or specific portions thereof have been accepted by the Owner.

 - .4 Report existing unknown services encountered during excavation to Consultant for instructions; cut back and cap or plug unused services. Be responsible for the protection of all active services encountered and for repair of such services if damaged.

END OF SECTION

- 1 GENERAL
 - .1 Include the aggregate total of all allowances listed below in the Bid Price.
 - .2 Expend Cash Allowances as directed by the Consultant. Each Cash Allowance will be adjusted to actual cost as defined hereunder and Contract Price will be amended accordingly by written order.
 - .3 Progress payments for work and material authorized under Cash Allowances will be made in accordance with GC 5.3 of the Contract. Cash allowances do not include H.S.T.
- 2 MATERIAL ALLOWANCES (SUPPLY ONLY)
 - .1 Material cash allowance shall include and provide payment for:
 - .1 Net cost of material.
 - .2 Applicable duties and taxes.
 - .3 Delivery to site.
 - .2 Include in the Bid Price, in addition to the material cash allowance, costs for the following:
 - .1 Handling at site, including unloading, uncrating, storage and hoisting.
 - .2 Protection from damage by elements or otherwise.
 - .3 Labour for installation and finishing.
 - .4 Other expenses required to complete installation.
 - .5 Overhead and profit.
- 3 ASSEMBLY ALLOWANCES (SUPPLY AND INSTALL)
 - .1 Assembly cash allowance shall include and provide payment for:
 - .1 Net cost of material.
 - .2 Applicable duties and taxes.
 - .3 Delivery to site.
 - .4 Assembly contractors'/suppliers' only, expenses relating to the following:
 - .1 Handling at site, including unloading, uncrating, storage and hoisting.
 - .2 Protection from damage by elements or otherwise.
 - .3 Labour installation and finishing.
 - .4 Other expenses required to complete installation.
 - .5 Overhead and profit.
 - .2 Include in the Bid Price any overhead and profit or related General Contractor costs.
- 4 TESTING & LABORATORY SERVICES
 - .1 Testing & Laboratory Services allowances shall include and provide payment for:
 - .1 Transportation costs to and from the site,
 - .2 Accommodation,
 - .3 Equipment required to perform tests or inspections,
 - .4 Costs of shipping samples to laboratory for testing,
 - .5 Applicable duties and taxes,
- 5 ALLOWANCE AMOUNTS
 - .1 The Total Cash Allowance to be included in the Stipulated Price is **Two Hundred Twenty-Five Thousand Dollars (\$225,000)** in Canadian funds. The cash allowance shall provide payment for the following in general:
 - .1 Inspection & Testing Services..... \$60,000
 - .2 Interior & Exterior Signage \$100,000
 - .3 Door Hardware \$65,000

END OF SECTION

1 MODIFICATIONS TO CONTRACT

- .1 Supplemental Instruction: as issued by the Consultant, consistent with the intent of the Contract Documents, and will not involve an adjustment in Contract Price or Contract Time.
- .2 Proposed Change: as issued by the Consultant, will notify the Contractor of an impending or proposed change to the Work, and will require submission of a quotation from the Contractor and all affected Subcontractors for each item noted. Submit quotation within the time period stipulated on the form, and indicate separate line items for labour and materials in each case. Work outlined in a Proposed Change must not proceed without the issuance of a Change Order signed by the Owner.
- .3 Change Directive: will be issued by the Consultant where an immediate response is required to an on-site condition. This form will authorize the Contractor to proceed with the change, with the stipulation that accurate accounts of costs be recorded, and may contain an upset cost, as agreed upon by the Owner and the Contractor.
- .4 Change Order: will be issued by the Consultant upon review and approval of quotations for a Proposed Change, or a Change Directive, and authorizes the Contractor to proceed with the change(s) proposed. A Change Order will amend the Contract Price, and/or the Contract Time.

2 UNIT PRICES

- .1 Apply Unit Prices quoted in Appendix UP of the Bid Form to extras to the Contract. Apply Unit Prices for credits from the Contract at a rate not less than 85% of the quoted Unit Price.
- .2 Work covered by Unit Prices will be executed in accordance with the Contract Documents. Unit Prices include all costs related to materials, labour, equipment, delivery and handling, statutory charges, overhead and profit, other related charges, and inclusive of all applicable duties and taxes (excluded HST), measured in place prior to excavation, or compacted/complete in place.

3 FEES FOR CHANGES IN THE WORK

- .1 Fees will apply to the Contract Price for changes to the Work, and shall include all statutory charges, applicable duties and taxes, charges required by labour agreements in force, charges related to site and/or office overhead, project management and administration, all shop and field supervision, clerical, drafting, bonding costs, permits, associated payroll costs, and other charges incidental to the work including but not limited to handling, equipment warranty, identification, coordination, scheduling, Bill 208 and WHMIS.
- .2 The Fees For Changes In The Work shall apply only to extras to the Contract. Contractor or Subcontractor mark-up will not be applied to credits.

- .3 For all Changes to the Work which may be ordered by the Owner, the maximum net mark-ups for overhead and profit for adjustments in Contract Price, shall be in accordance with the Contract.

END OF SECTION

- 1 APPLICATIONS FOR PAYMENT
 - .1 Applications for payment on account may be made monthly as the Work progresses, and shall be preceded by the submission of a Schedule of Values for review by the Owner and Consultant, in accordance with the Contract.
 - .2 The second and all subsequent applications for payment shall include a statement based on the Schedule of Values, a statutory declaration (CCDC 9B), and a standard Workers Compensation Certificate of Clearance.
 - .3 Applications for Payment must take the form of a *Proper Invoice* and shall mean a written bill or other request for payment for services and/or materials comprising the *Work* performed under this *Contract* issued by the *Contractor*, provided such bill or request:
 - .1 Contains the information set out in Section 6.1 of the *Construction Act*, which for certainty includes the following:
 - .1 The *Contractor's* name and address;
 - .2 The *Owner's* name and address;
 - .3 The date of the invoice and the period during which the services or materials were supplied;
 - .4 Information identifying the authority, whether in this *Contract* or otherwise, under which the services or materials were supplied;
 - .5 A description, including quantity where appropriate, of the services or materials that were supplied;
 - .6 The amount payable for the services or materials that were supplied, and the payment terms;
 - .7 The name, title, telephone number and mailing address of the person at the *Contractor* to whom payment is to be sent; and
 - .8 Any other information that may be prescribed by the *Construction Act*."
 - .2 Contains the following information and meets the following requirements:
 - .1 The name of the Owner's project manager for the Project;
 - .2 The Owner's full legal name;
 - .3 The amount invoiced must not exceed the amount of the Owner's purchase order to which the invoice relates;
 - .4 Includes the applicable purchase order number, tax registration number and project number applicable to the Work;
 - .5 The amount invoiced must not be combined with any other invoices when issued;

- .6 Outlines the aggregate amount of the holdback retained by the Owner under the Contract and the amount of the holdback retained under and applicable to the amount invoiced;
 - .7 The amount invoiced must accurately reflect all required components of the Work and the values attributed to these components; and
 - .8 The invoice must include a statement in large font all in uppercase as follows: "THE CONSTRUCTION ACT, AS REVISED, IS APPLICABLE TO THIS INVOICE",
- .3 Meets the additional requirements with respect to process and contain such information as required by Owner.

2 SCHEDULE OF VALUES

- .1 Submit Schedule of Values in spreadsheet form acceptable to the Construction Manager and Consultant.
- .2 Identify on each Schedule of Values, the following information:
 - .1 Date of Issue
 - .2 Project name
 - .3 Subcontractor's name
 - .4 Payment period
 - .5 Payment certificate number
- .3 Items of work listed shall include, but not be limited to, separate line items for the following:
 - .1 General Accounts
 - .2 Mobilization
 - .3 Supervision
 - .4 Bonds and Insurance, Permits and Licenses
 - .5 Operations and Maintenance Manuals/As-Built Drawings
 - .6 All trades or portions of the Work, generally in chronological order
 - .7 Provision of other Products and/or services
 - .8 Cash Allowance expenditures
 - .9 Changes in the Work
- .4 The total Contract amount for each trade or portion of the Work shall be listed beside each item.
- .5 The Values of the Work shall be listed as to the aggregate percentage and dollar value completed, under the following major headings:
 - .1 Initial Contract Amounts for each line item,
 - .2 Progress to Date,
 - .3 Percent Complete,

- .4 Current Invoice,
 - .5 Previous Billings,
 - .6 Contract Balance
- .6 Work shall be subtotaled under original Contract amounts, Cash Allowance expenditures, and Changes to the Work.
- .7 Final totals shall identify:
- .1 Total amount
 - .2 Holdback deducted
 - .3 Holdback released
 - .4 Amount invoiced to date
 - .5 Net amount
 - .6 HST
 - .7 Amount due this Certificate

END OF SECTION

1 PROJECT MANAGEMENT & COORDINATION

.1 Project Coordination

.1 The Contractor is responsible for the overall coordination of the Work. Coordinate the work of all subcontractors, and provide such assistance as is necessary, including but not limited to;

.1 Providing site dimensions and layout,

.2 Providing temporary facilities and controls,

.3 Scheduling subcontractors work to prevent conflicts,

.4 Scheduling and administering regular subtrade scheduling and coordination meetings throughout progress of the Work.

.5 Scheduling and administering regular subtrade safety meetings throughout progress of the Work.

.6 Coordinate construction sequences and schedules including all components of the Work, including all Divisions with interdependent responsibilities.

.2 The Contractor shall facilitate production of interference drawings where necessary for coordination of the Work. Provide such interference drawings to the Consultant for review.

.2 Project Supervision

.1 The Contractor shall provide and maintain full-time supervision on site. The supervisor shall be responsible for the overall day-to-day coordination on site between subtrades.

.2 The supervisor shall coordinate the work of all subcontractors, and provide such assistance as is necessary, including but not limited to;

.1 Layout,

.2 Rough carpentry work for blocking, strapping, nailers, etc.

.3 Project Meetings

.1 Schedule and administer regular project progress meetings throughout progress of work. Frequency of meetings shall be bi-weekly.

.2 Distribute written notice of each meeting to Owner & Consultant four days in advance of meeting date.

.3 Provide physical space and make arrangements for meetings.

.4 Record minutes. Itemize significant proceedings and decisions. Identify 'action by' appropriate parties.

- .5 Distribute copies of minutes after each meeting and transmit to meeting participants and affected parties not in attendance.

- .4 Project Site Administration
 - .1 Maintain at job site, one copy each of the following:
 - .1 Contract drawings.
 - .2 Project manual.
 - .3 Addenda and Bid Revisions.
 - .4 Reviewed shop drawings.
 - .5 Change orders and other Contract modifications.
 - .6 Field test and inspection reports.
 - .7 Approved schedules.
 - .8 Manufacturer's installation and application instructions.
 - .9 Building Permit & Permit Drawings.

- 2 SCHEDULES
 - .1 Construction Progress Schedule.
 - .1 Prepare schedule in horizontal chart form, with weekly horizontal time scale identifying first/last work day of each week. Schedule must utilize "critical path" method.

 - .2 Submit schedule using project scheduling software such as Microsoft Project or Primavera.

 - .3 Indicate separate line for each trade or operation of the Work. Arrange trades in chronological order for commencement of that part of the Work.

 - .4 Set up format to permit plotting of actual construction progress against scheduled progress.

 - .5 Schedule shall show:
 - .1 Commencement and completion dates of Contract.
 - .2 Commencement and completion dates of construction stages/phases, if any.
 - .3 Commencement and completion dates of each trade. Major trades shall be further broken down as directed by Consultant; generally follow Specification format.
 - .4 Order and delivery dates for major or critical equipment.
 - .5 Critical dates for shop drawing/sample submissions.
 - .6 Any other information relating to orderly progress of Contract, considered by Contractor or Consultant to be pertinent.

- .6 Consultant, together with Contractor, shall review construction progress once a month during or immediately following regular site meeting, or more often as directed by Consultant.
- .7 Update construction schedule, whenever changes occur, in manner and at times acceptable to Consultant. Include with each update a written report of activity progress reflected in the revised critical path schedule, and the corrective actions which have been or are to be taken to maintain progress on the schedule in the future, anticipated delay, resource availability, schedule changes, and work to be completed in the next 2 month period.
- .8 Plot actual construction progress on schedule at least once a week.
- .9 Submit copy of schedule showing actual progress, to Consultant once a month, concurrently with application for payment.
- .10 Include with each update a written report of activity progress reflected in the revised critical path schedule, and the corrective actions which have been or are to be taken to maintain progress on the schedule in the future, anticipated delays, resource availability, schedule changes, and work to be completed in the next 2 month period.
- .2 Cash Flow Schedule
 - .1 Once the Construction Progress Schedule has been approved, submit a detailed Cash Flow Schedule.
 - .2 The Construction Manager shall expand the approved Schedule of Values to act as their Cash Flow Schedule;
 - .1 Cash Flow Schedule shall be broken down by each element of the Schedule of Values, over each month of the Project;
 - .2 Schedule shall be presented to reflect projected amounts for each month as well as the actual amounts for the months where payments have been received;
 - .3 Submit Schedule to the Consultant in PDF format as part of the Construction Manager's monthly report.
 - .3 Update cash flow chart whenever changes occur to scheduling and in manner and at times satisfactory to Consultant.
- .3 Submittal Schedule
 - .1 Provide schedule for submittal of all Shop Drawings, Product Data and Samples.

- .2 Provide complete list of all manufactured products to be used in the course of the Work, including those amended by addenda.
- .4 Submission of Schedules
 - .1 Submit one PDF copy of each schedule to the Consultant for review, prior to first progress billing. Amend schedule as required.
 - .2 Submit copy of each subsequent issue of schedules to the Consultant.
 - .3 Update schedule on a regular basis or as requested by the Consultant.
- 3 ADDITIONAL DOCUMENTS
 - .1 Consultant may issue additional documents in the form of drawings, specifications, schedules, or written instructions to assist proper execution of the Work. These documents shall take one of the following forms as defined in the Contract;
 - .1 Supplemental Instruction: no adjustment in Contract Price or Contract Time.
 - .2 Change Order: amendment to the Contract recommended by the Consultant, and agreed upon by the Owner and the Contractor.
- 4 SUBMITTAL PROCEDURES
 - .1 Submit to Consultant, all items specified for review, 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 and no claim for extension by reason of such default will be allowed.
 - .2 Schedule submissions at least 15 working days before reviewed submissions will be needed.
 - .3 Do not proceed with work affected by the submittal until review is complete.
 - .4 Review all submittals prior to submission to the Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with the requirements of the Work and the Contract Documents. Submittals not stamped, signed, and dated will be returned without review.
 - .5 Verify field measurements and affected adjacent work are coordinated.

- .6 Contractor's responsibility for errors and omissions in submission, or deviations from requirements of Contract Documents, is not relieved by Consultant's review of submittals.
- .7 Keep one reviewed copy of each submission on site.
- .8 Shop Drawings
 - .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by the Contractor to illustrate details of a portion of the Work.
 - .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of the Section under which the adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
 - .3 Adjustments made on shop drawings by the Consultant are not intended to change the Contract Price. If adjustments affect the value of Work, state such in writing to the Consultant prior to proceeding with the Work.
 - .4 Make changes in shop drawings as the Consultant may require, consistent with Contract Documents. When resubmitting, notify the Consultant in writing of any revisions other than those requested.
 - .5 Submit all shop drawings in electronic copy (PDF) .
 - .6 Shop drawings submitted in any other form are not acceptable, and will not be reviewed.
 - .7 Reproductions of Consultants' drawings are acceptable for the purpose of creating Shop Drawings, provided they indicate all necessary fabrication, erection, construction, and installation details, in addition to the detail shown on the Consultants' drawings.
 - .8 Electronic files of Architectural Drawings may be obtained for the purpose of creating Shop Drawings. Make arrangements with the Consultants to obtain such files.

- .9 Shop drawings not submitted in the scale type of the Contract Documents (ie. metric for metric drawings) will not be reviewed.
 - .10 Shop drawings requiring professional engineer's seal and signature, submitted without it, will be returned "Not Reviewed".
 - .11 Shop drawings which require the approval of a legally constituted authority having jurisdiction shall be submitted by Contractor to such authority for approval. Such shop drawings shall receive final approval of authority having jurisdiction before Consultant's final review.
 - .12 No work requiring a shop drawing submission shall be commenced until the submission has received Consultant's final review.
 - .13 The Consultant's review is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and this review shall not relieve the Contractor of his responsibility for meeting the requirements of the Contract Documents. The Contractor is 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 subtrades.
- .9 Product Data Sheets
- .1 Manufacturer's standard schematics, catalogue sheets, diagrams, schedules, performance charts, illustrations and other descriptive data are acceptable in lieu of shop drawings, where specified.
 - .2 Product Data Sheets are acceptable provided they conform to the following:
 - .1 Information not applicable to project has been deleted.
 - .2 Supplement standard information to provide additional information applicable to project.
 - .3 Show dimensions and clearances required.
 - .4 Show performance characteristics and capacities.
 - .5 Show wiring diagrams, when requested, and controls.
 - .3 Submit product data sheets or brochures for requirements requested in specification Sections and as the Consultant may reasonably request where shop drawings will not be prepared due to standardized manufacture of product.

- .4 Submit electronic copy of all WHMIS Data Sheets.
- .5 Submit all Product Data Sheets in electronic copy (PDF) only.
- .6 Product data sheets submitted in any other form are not acceptable, and will not be reviewed.
- .10 Return of Submissions
 - .1 If upon review by the Consultant, no errors or omissions are discovered or if only minor corrections are made, one shop drawing or product data will be returned and fabrication and installation of Work may proceed. Contractor shall arrange and pay for prints required for distribution to Subcontractors, suppliers and site office.
 - .2 If shop drawings or data sheets are rejected, noted copy will be returned and resubmission of corrected shop drawings or data sheets through the same procedure indicated above, shall be performed before fabrication and installation of Work may proceed.
- .11 Samples
 - .1 Submit samples for review, in duplicate, in sizes requested in respective specification sections. Label samples as to origin and intended use in the Work.
 - .2 Where colour, pattern or texture is criteria, submit full range of samples.
 - .3 Deliver samples prepaid to Consultant's office.
 - .4 Notify the Consultant in writing, at the time of submission of deviations in samples from requirements of Contract Documents.
 - .5 Adjustments made on samples by the Consultant are not intended to change the Contract Price. If adjustments affect the value of Work, state such in writing to the Consultant prior to proceeding with the work.
 - .6 Make changes in samples which the Consultant may require, consistent with Contract Documents.
 - .7 Reviewed samples or mock-ups will become standards of workmanship and material against which installed work will be checked on project.

.12 Submission Requirements

- .1 Submissions shall include (where applicable) :
 - .1 Date and revision date,
 - .2 Project title and number,
 - .3 Names of Contractor, Subcontractor(s),
Supplier/Manufacturer,
 - .4 Identification of Product or material,
 - .5 Field dimensions, clearly identified as such,
 - .6 Contractor's stamp, initialled or signed, certifying review of
submission, and verification of field measurements.

END OF SECTION

1 GENERAL

- .1 Provide construction photographs in accordance with procedures and submission requirements specified in this section.
- .2 Photographs shall be taken using a digital camera.

2 PROGRESS PHOTOGRAPHS

- .1 Provide digital sets of construction photographs, documenting progress of the Work, with each monthly progress draw. Submit digital images on a USB Thumbdrive or via email.
- .2 Submit progress photographs with each monthly progress draw, and at the following milestones:
 - .1 Completion of buried services installation before backfilling,
 - .2 Completion of excavation and pouring of footings,
 - .3 Completion of footings or foundation work,
 - .4 Completion of superstructure and each floor of new building structure,
 - .5 Completion of exterior wall construction,
 - .6 Completion of window door and glazing work,
 - .7 Completion of roofing,
 - .8 Completion of mechanical and electrical rough-in work,
 - .9 Completion of Interior partitions work,
 - .10 Completion of Drywall and acoustics,
 - .11 Completion of Flooring,
 - .12 Completion of each major Finish,
 - .13 Completion of asphalt and concrete paving,
 - .14 Completion of landscaping.
 - .15 In General:
 - .1 Months 1 & 2: minimum 4 views
 - .2 Months 3 & 4: minimum 8 views each month
 - .3 Month 5 to completion: minimum 12 views each
- .3 Orientation of Photographs: provide photos from 2 general viewpoints, as well as specific views as required by milestones specified above, and as determined by Consultant prior to first Progress Draw.

3 FINAL PHOTOGRAPHS

- .1 Submit USB Thumbdrive copy of all progress photographs, organized by date, with Operations & Maintenance Manuals at the completion of the project.
- .2 Orientation of Photographs: provide final photos as follows:
 - .1 General viewpoints as defined above,
 - .2 Views of all exterior elevations,

- .3 One view from each street,
- .4 Views of site showing new concrete paving and landscaping,
- .5 Interior views of all major spaces.

END OF SECTION

1 GENERAL

1.1 SECTION INCLUDES

- .1 Requirements for quality of work.
- .2 Requirements for for material inspection and testing.
- .3 Requirements for determination of defective materials and work.

1.2 REFERENCE STANDARDS

- .1 CSA A23.1; Concrete Materials and Methods of Concrete Construction.
- .2 CSA A23.2; Methods of Test for Concrete.
- .3 CSA S16.1; Limit States Design of Steel Structures.
- .4 CSA W47.1; Certification of Companies for Fusion Welding of Steel Structures.
- .5 CSA W59; Welded Steel Construction (Metal Arc Welding).
- .6 CISC; Code of Standard Practice for Structural Steel.
- .7 OPSS; Ontario Provincial Standard Specifications.

1.3 REGULATORY REQUIREMENTS

- .1 Products and services provided to complete the Work shall meet or exceed requirements of specified standards, municipal by-laws, building codes and referenced documents.

1.4 INDEPENDENT INSPECTION AND TESTING

- .1 Independent Inspection and Testing Consultants will be engaged by the Owner, for the purpose of inspecting and/or testing individual portions of the Work. The initial cost of such services will be included in the Contract Price, as allocated under Section 01 21 00, Allowances.

1.5 RESPONSIBILITIES

- .1 Inspection and Testing Consultants
 - .1 Inspection and Testing Consultants shall;
 - .1 Provide inspection and testing specified,
 - .2 Inform the Contractor and Consultant immediately upon observance of materials, systems, or procedures not in compliance with the specifications, and
 - .3 Submit complete reports to the Contractor and the Consultant in a timely manner.
- .2 Contractor
 - .1 Contractor shall:
 - .1 Provide access to the Work for Inspection/Testing Consultants, and
 - .2 Inform the Inspection/Testing Consultants in advance of day and time required for inspection and tests.

- .2 It is the responsibility of the General Contractor to ensure the quality control requirements of the Contract are implemented.
- .3 Consultant
 - .1 The Consultant will make final decisions on changes to the scope of work of inspection and testing that may affect the Contract Price.
 - .2 When informed of of any material procedure or test result that does not meet or exceed the specifications, the Consultant will respond in an expedient manner to resolve the issue.
- 1.6 ACCESS TO WORK
 - .1 Allow inspection & testing companies access to the Work, as well as off site manufacturing and fabrication plants.
- 1.7 REPORTS
 - .1 Submit electronic copies of inspection and test reports to the Consultant.
 - .2 Provide copies to Subcontractor of work being inspected or tested, manufacturer or fabricator of material being inspected or tested.
 - .3 Submit electronic copy of inspection and test reports to the Building Official having jurisdiction, where required by that official.
 - .4 The cost of tests beyond those called for in the Contract Documents or beyond those required by the law of the Place of Work shall be appraised by the Consultant and may be authorized as recoverable.
- 1.8 EARTHWORK
 - .1 All earthwork shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:
 - .1 Inspection of excavations for foundations.
 - .2 Inspection of subgrade and granular fill materials.
 - .3 Inspection of backfill operations.
 - .4 Inspection and testing of backfill compaction.
 - .5 Inspection of trenching & bedding associated with underground services.
 - .6 Inspection and testing of fill & compaction associated with underground services.
- 1.9 CAST-IN-PLACE CONCRETE
 - .1 All cast-in-place concrete shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:
 - .1 Verification of materials delivered to site.
 - .2 Slump tests.
 - .3 Sampling of cylinders, and compressive strength tests.

1.10 MASONRY MORTAR

- .1 All masonry mortar shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:
 - .1 Visual inspection of all materials.
 - .2 Sampling and testing of mortar cubes.

1.11 STRUCTURAL STEEL

- .1 All structural steel shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:
 - .1 Confirmation that materials supplied meet specifications.
 - .2 Shop inspection during fabrication of steel.
 - .3 Checking welders' CWB Certification.
 - .4 Checking fabricated members against design member shapes.
 - .5 Checking fabricated members against allowable sweep and camber.
 - .6 Checking fabricated members against specified camber.
 - .7 Visual inspection of all welded connections including spot checking of joint preparation and fit-up.
 - .8 Non-destructive testing of welding.
 - .9 Sample checking that tolerances are not exceeded during erection including fit-up of field welded joints.
 - .10 Inspection of field cutting.
 - .11 Inspection and testing of all field bolted connections.
 - .12 Visual inspection of all welds securing steel deck to structural steel.
 - .13 Visual inspection of all bearing plate locations.

1.12 STRUCTURAL STEEL STUDS

- .1 All structural steel studs shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:
 - .1 Confirmation that materials supplied meet specifications.
 - .2 Shop inspection during fabrication.
 - .3 Checking welders' CWB Certification.
 - .4 Checking fabricated members against design member shapes.
 - .5 Visual inspection of all welded connections including spot checking of joint preparation and fit-up.
 - .6 Sample checking that tolerances are not exceeded during erection including fit-up of field welded joints.
 - .7 Inspection of all field bolted or welded connections.

1.13 WATERPROOFING

- .1 All waterproofing components shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:
 - .1 Visual inspection of total membrane for defects.
 - .2 Visual inspection of all transitions and detailing at penetrations.
 - .3 Mil thickness testing of liquid membrane thickness.

1.14 SPRAY-IN-PLACE INSULATION

- .1 All spray-in-place insulation shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:
 - .1 Visual inspection of total application for defects.
 - .2 Visual inspection of all transitions and detailing at penetrations.
 - .3 Verification of applied thickness.

1.15 AIR BARRIER

- .1 All building envelope air barrier components shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:
 - .1 Visual inspection of total membrane for defects.
 - .2 Visual inspection of all transition membranes.
 - .3 Mil thickness testing of liquid air barrier membrane thickness.
 - .4 Pull test to verify adhesion.

1.16 ASPHALT PAVING

- .1 All asphalt paving shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:
 - .1 Inspection and compaction testing of all granular base courses.
 - .2 Marshal Density testing of asphalt material.
 - .3 Compaction testing of all courses of asphalt paving.

1.17 SPRAY-APPLIED FIRE PROTECTION, FIRESTOPS AND SMOKE SEALS

- .1 All spray-applied fire protection, firestopping and smoke seals shall be subject to inspection as specified herein. Inspection and Testing shall include:
 - .1 Inspection of materials to verify compliance with specifications.
 - .2 Visual inspection of all applications.

1.18 ROOFING

- .1 All roofing shall be subject to inspection as specified herein. Inspection and Testing shall include:
 - .1 Inspection of all roofing materials to verify compliance with specifications.
 - .2 Inspection of roofing application.

1.19 WINDOWS, CURTAIN WALLS, ENTRANCES AND GLAZING

- .1 All exterior window frames, curtain wall entrance frames and glazing shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:
 - .1 Inspection of all components and materials to verify compliance with specifications.
 - .2 Inspection of all framing installation methods, including fastenings, required reinforcement, sills and trim, air barrier tie-ins, and sealant applications.

- .3 Inspection of glazing methods, materials and installation.

2 PRODUCTS

(RESERVED)

3 EXECUTION

3.1 INSPECTION AND TESTING - GENERAL

- .1 Furnish test results and mix designs as may be requested.
- .2 The cost of tests and mix designs beyond those called for in the Contract Documents or beyond those required by the law of the Place of Work shall be appraised by the Consultant and may be authorized as recoverable.

3.2 INSPECTION AND TESTING - PROCEDURES

- .1 Notify the appropriate agency and Consultant in advance of the requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in the Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store, cure and inspect test samples.

3.3 QUALITY OF THE WORK

- .1 Quality of the Work shall be first class, executed by workers experienced and skilled in the respective duties for which they are employed. Immediately notify the Consultant if required work is such as to make it impractical to produce required results.
- .2 Do not employ any unfit person or anyone unskilled in their required duties. The Consultant reserves the right to require the dismissal from the site, of workers deemed incompetent, careless, insubordinate or otherwise objectionable.

3.4 DEFECTIVE MATERIALS AND WORK

- .1 Where evidence exists that defective work has occurred, or that work has been carried out incorporating defective products, the Consultant may have independent tests, inspections, or surveys performed in order to determine if work is defective.
- .2 Tests, inspections, or surveys carried out under these circumstances will be made at the Contractor's expense in the event of defective work, or at the Owner's expense where work is in conformance. Where tests

incorporate a number of samples, payment will be assessed, by the Consultant, based on the ratio of conforming to non-conforming results. This does not include re-testing of soil compaction during placement, where evidence exists of non-conformance with the Contract documents, but rather only if re-testing is called for after completion of compaction.

END OF SECTION

1 CODES AND STANDARDS

.1 Codes

.1 All construction shall conform to the Ontario Building Code, the National Building Code (NBC), Ontario Fire Code (OFC) and the National Fire Code (NFC) latest editions including all supplements and amendments.

.2 Conform to all other codes, by-laws and regulations as specified within individual sections of the specifications.

.2 Industry Standards

.1 Industry Standards are specified within individual sections as applicable to those portions of the Work. The latest editions of all industry standards shall be the standards for which quality of work shall be assessed.

.2 Comply with all relevant codes, standards and industry-accepted practices, as specified herein, or as applicable to the Work.

2 AUTHORITIES HAVING JURISDICTION

.1 The Chief Building Official of the Municipality of the Place of the Work, is the primary Authority Having Jurisdiction for compliance with all codes, by-laws and regulations as they apply to all construction.

.2 Other Authorities Having Jurisdiction may be required to review and approve certain portions of the Work. The Chief Building Official of the Municipality of the Place of the Work, will determine the requirements for such involvement.

3 PERMITS AND FEES

.1 No construction work may commence without a valid, posted Building Permit.

.2 The Owner is responsible for obtaining all necessary information and applying for the Building Permit, including payment of associated fees. The Contractor shall pick up the approved permit from the Building Department, and post it at the Place of the Work.

.3 Subcontractors are responsible for applying for, and obtaining all necessary permits, licenses, or certificates required by their portion of the Work.

.4 Authorities Having Jurisdiction may levy fees for issuing permits, licenses, or certificates under their jurisdiction. Subcontractors shall pay all such

fees as required, and shall include the cost of such fees in their Contract Prices as a separate line item.

- .5 Provide certificates and permits from other Authorities Having Jurisdiction when so requested.
- .6 Prior to commencement of construction, post the Building Permit at the Place of the Work.

END OF SECTION

Abbreviations listed, when used in the Specifications, shall have the following meanings:

ABBREVIATION	MEANING
AA	ALUMINUM ASSOCIATION
AAMA ASSOCIATION	ARCHITECTURAL ALUMINUM MANUFACTURERS`
AASHO	AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS
ACI	AMERICAN CONCRETE INSTITUTE
AIA	AMERICAN INSTITUTE OF ARCHITECTS
AIMA	ACOUSTICAL & INSULATING MATERIALS ASSOCIATION
AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AISI	AMERICAN IRON AND STEEL INSTITUTE
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
ASHRAE	AMERICAN SOCIETY OF HEATING, REFRIGERATING & AIR CONDITIONING ENGINEERS
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWI	ARCHITECTURAL WOODWORK INSTITUTE (USA)
AWMAC	ARCHITECTURAL WOODWORK MANUFACTURERS ASSOCIATION OF CANADA
AWS	AMERICAN WELDING SOCIETY
CCA	CANADIAN CONSTRUCTION ASSOCIATION
CCRC	CANADIAN CODE FOR RESIDENTIAL CONSTRUCTION
CEC	CANADIAN ELECTRICAL CODE
CFUA	CANADIAN FIRE UNDERWRITERS ASSOCIATION
CGA	CANADIAN GAS ASSOCIATION
CGSB	CANADIAN GENERAL STANDARDS BOARD
CISC	CANADIAN INSTITUTE OF STEEL CONSTRUCTION
CITC	CANADIAN INSTITUTE OF TIMBER CONSTRUCTION
CLA	CANADIAN LUMBER ASSOCIATION
CMHC	CANADA MORTGAGE & HOUSING CORPORATION
COFI	COUNCIL OF FOREST INDUSTRIES OF BRITISH COLUMBIA
CPCI	CANADIAN PRESTRESSED CONCRETE INSTITUTE
CRCA	CANADIAN ROOFING CONTRACTORS ASSOCIATION
CSA	CANADIAN STANDARDS ASSOCIATION
CSC	CONSTRUCTION SPECIFICATIONS CANADA
CSI	CONSTRUCTION SPECIFICATIONS INSTITUTE (USA)
CSPI	CORRUGATED STEEL PIPE INSTITUTE
CSSBI	CANADIAN SHEET STEEL BUILDING INSTITUTE
CWB	CANADIAN WELDING BUREAU
CWC	CANADIAN WOOD COUNCIL
DND	DEPARTMENT OF NATIONAL DEFENCE, CANADA
FM	FACTORY MUTUAL ENGINEERING CORPORATION
FS	FEDERAL SPECIFICATION (USA)
IGMAC	INSULATED GLASS MANUFACTURERS ASSOCIATION OF

CANADA	
LTIC	LAMINATED TIMBER INSTITUTE OF CANADA
MIA	MARBLE INSTITUTE OF AMERICA
MPMDD	MODIFIED PROCTOR MAXIMUM DRY DENSITY
NAAMM	NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (USA)
NBFU	NATIONAL BOARD OF FIRE UNDERWRITERS
NBC	NATIONAL BUILDING CODE OF CANADA
NBS	NATIONAL BUREAU OF STANDARDS (USDC)
NEMA	NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NHLA	NATIONAL HARDWOOD LUMBER ASSOCIATION (USA)
NLGA	NATIONAL LUMBER GRADES AUTHORITY
NRC	NATIONAL RESEARCH COUNCIL
OBC	ONTARIO BUILDING CODE
OHSA	OCCUPATIONAL HEALTH AND SAFETY ACT
OPSS	ONTARIO PROVINCIAL STANDARD SPECIFICATIONS
PCA	PORTLAND CEMENT ASSOCIATION
PCI	PRESTRESSED CONCRETE INSTITUTE
SDI	STEEL DECK INSTITUTE
SPMDD	STANDARD PROCTOR MAXIMUM DRY DENSITY
SSPC	STEEL STRUCTURES PAINTING COUNCIL
TTMAC	TERRAZZO, TILE & MARBLE ASSOCIATION OF CANADA
ULC	UNDERWRITERS LABORATORIES CANADA
UL	UNDERWRITERS LABORATORIES (USA)
USAS	UNITED STATES OF AMERICA STANDARDS INSTITUTE
WSIB	WORKPLACE SAFETY AND INSURANCE BOARD

END OF SECTION

1 REFERENCES

- .1 Occupational Health and Safety Act.
- .2 National Fire Code of Canada
- .3 Ontario Building Code
- .4 Ontario Fire Code.

2 INSTALLATION AND REMOVAL

- .1 Provide temporary utilities, facilities and controls in order to execute the work expeditiously. Remove from site all such work after use.

3 VEHICULAR ACCESS & PARKING

- .1 Construction access only as designated by the Owner. Maintain access throughout the course of the Work.
- .2 Where site access for construction vehicles necessitates use of public roads, regularly remove mud and dirt from such roads where contaminated by construction vehicles.
- .3 Traffic Control: Provide and maintain flagpersons, traffic signals, barricades and flares, lights, or lanterns as required to perform the work and protect the public.
- .4 Construction Parking
 - .1 Parking for construction equipment vehicles will be limited to the site or immediate areas of work.
 - .2 Parking for Contractors' and Subcontractors' personal vehicles will be permitted on site, provided they do not interfere with the performance of the Work.

4 TEMPORARY UTILITIES

- .1 Temporary Electricity and Lighting
 - .1 Connect to power supply in accordance with the Electrical Code.
 - .2 Electrical power and lighting systems installed under this contract can be used for construction requirements provided that guarantees are not affected thereby. Make good damage. Replace lamps which have been used more than a period of 3 months.
 - .3 Provide temporary lighting in all areas of construction, to 1.5x the minimum requirements of the Occupational Health and Safety Act.
- .2 Temporary Water Supply
 - .1 Provide temporary water supply for construction operations.

- .2 Permanent water supply system installed under this contract can be used for construction requirements provided that guarantees are not affected thereby. Make good damage.

- .3 Temporary Heating and Ventilating
 - .1 Provide and maintain all temporary heat and ventilation necessary during construction, including cost of installation, fuel, operation, attendance and maintenance. Use of direct-fired heaters discharging waste products into work areas will not be permitted unless prior approval is given by Consultant.

 - .2 Provide all temporary heating equipment and fuel sources necessary to perform the work in winter conditions. All fuel sources and equipment shall conform to all federal and provincial legislation for the storage and handling of such fuels.

 - .3 Provide and maintain all temporary hoarding and enclosures for winter work.

 - .4 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of work.
 - .2 Protect work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.

 - .5 Maintain minimum temperature of 10°C or higher where construction is in progress and maintain until acceptance of structure by Consultant.

 - .6 Ventilating
 - .1 Prevent hazardous accumulation of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Ventilate temporary sanitary facilities.

- .6 Continue operation of ventilation and exhaust system for a time after cessation of work process, to assure removal of harmful elements.

5 CONSTRUCTION FACILITIES

.1 Field Office

- .1 Provide field office and furnish appropriately with desk, drawing layout table, filing cabinet, etc. Field office shall provide space for site meetings, with table and seating for 12 persons.
- .2 Provide minimum 750 Lx lighting level.
- .3 Heat to maintain 22°C inside temperature.
- .4 Provide 2 operable windows for cross ventilation, or air conditioning.

.2 Temporary Telephone and Facsimile

- .1 Provide and pay for temporary telephone and FAX machine to be installed in Field Office. Cellular telephones are acceptable. Pay telephone is not acceptable.
- .2 Provide data lines and computer hook-up with ability to send/receive email.

.3 Equipment, Tools and Materials Storage

- .1 Provide adequate weathertight enclosures with raised floors, for storage of materials, tools, and equipment subject to damage by weather.
- .2 Temporary enclosures required by subtrades as workshops shall be provided by those trades.

.4 Site Storage and Overloading

- .1 Confine the Work and the operations of employees to limits indicated by the Contract Documents. Do not unreasonably encumber the premises with Products.
- .2 Do not load or permit to be loaded any part of the Work with a weight or force that will endanger the Work.

.5 Sanitary Facilities

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances. Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition. Where portable toilet facilities are

provided, empty and sanitize such facilities on a weekly basis, or more frequently if required.

.6 First Aid Facilities

- .1 Provide first aid facilities and supplies necessary to supply first aid to injured workers, in accordance with all applicable regulations.

6 CONSTRUCTION SAFETY MEASURES

- .1 Observe all construction safety measures as required by the General Conditions of the Contract, the Occupational Health and Safety Act, and by all authorities having jurisdiction, provided that in case of conflict or discrepancy, the more stringent requirements shall apply.

- .2 Provide applicable spare safety equipment such as helmets, safety glasses, and harnesses, and enforce their use by Consultants, the Owner, their representatives and any authorized visitors to the site.

- .3 Provide and maintain fences, gates and locks, covered walkways, guard rails, barriers, night lights, and appropriate warning signage as required for the protection of the public, and of public and private property; as required by the General Conditions of the Contract, the Occupational Health and Safety Act, and by all authorities having jurisdiction. Erect and maintain sturdy railings around shafts, and the like, to protect workmen and the public from injury.

.4 Workplace Hazardous Materials Information System

- .1 Comply with all requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets.

- .2 Include copies of all WHMIS data sheets in Operations and Maintenance Manuals.

7 CONSTRUCTION AIDS

.1 Falsework

- .1 Design and construct falsework in accordance with CSA S269.1.

.2 Scaffolding

- .1 Design, construct and maintain scaffolding in accordance with CSA S269.2. Erect scaffolding independent of walls. Remove promptly when no longer required.

.3 Hoisting

- .1 Provide, operate and maintain hoists or cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof. Hoists or cranes shall be operated by qualified operator.

8 TEMPORARY BARRIERS & ENCLOSURES

- .1 Hoarding & Site Fencing: shall consist of temporary modular welded wire mesh fencing.

- .1 Fencing shall be minimum 2440mm high.

- .2 Provide barriers around trees and planting beds designated to remain. Protect from damage. Refer also to Landscape drawings and specifications for tree protection provisions.

.2 Dust Screens

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

- .2 Dust screens shall consist of, as a minimum, 0.15mm thick polyethylene sheets secured to appropriate framing and sealed at all joints and at perimeter to prevent migration of dust.

.3 Temporary Partitions

- .1 Provide temporary partitions where indicated on the drawings, where required by authorities having jurisdiction, or where required by phasing of work.

- .2 Maintain temporary partitions throughout the duration of the project. Repair where damaged by construction operations. Remove promptly when required.

- .3 Temporary partitions shall consist of (3 5/8") 92mm steel studs with (5/8") 16mm Type X gypsum board both sides. Partitions shall be constructed as fire separations having a 1 hour fire resistance rating. Provide (3½") 89mm thick sound attenuation batt insulation.

9 TEMPORARY CONTROLS

.1 Drainage & Erosion Control

- .1 Refer to Section 01 57 19 – Temporary Environmental Controls.

.2 Site Signs and Notices

- .1 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Consultant.
- .2 No other signs or advertisements of any description except notices regarding safety and instruction, shall be put up around the building, or site, without the approval of the Owner.

END OF SECTION

1 REFERENCES

- .1 National Building Code of Canada
- .2 National Fire Code of Canada
- .3 Ontario Fire Code
- .4 Ontario Building Code
- .5 Guidelines for Maintaining Fire Safety during Construction in Existing Buildings, (10/31/88) Ontario Ministry of the Solicitor General, Office of the Fire Marshal.

2 FIRE SAFETY

- .1 Fire Fighting Equipment
 - .1 Provide and maintain in working order, ULC labelled, 9kg 4A 60BC type fire extinguishers, and locate in prominent positions to approval of authorities having jurisdiction.
- .2 Fire Department Access
 - .1 Provide and maintain fire access routes as designed, as soon as construction sequence will allow. Access routes must have compacted granular subbase, and base in place before superstructure of building may proceed.
 - .2 Construction activities must not obstruct access routes designated for fire department equipment. If necessary that existing access be obstructed or deleted, alternative access, acceptable to the fire department, must be provided prior to commencement of construction, in accordance with Ontario Building Code location and design criteria for required access routes.
- .3 Control of Combustible Materials
 - .1 The stockpiling of construction materials adjacent to the existing building must be carefully controlled in accordance with the Ontario Fire Code. Materials stored, and their proximity to, equipment used in construction may create a fire hazard. Control of combustibles on a construction site is regulated under the Occupational Health and Safety Act.
- .4 Hot Work
 - .1 Conform to the requirements of the Occupational Health and Safety Act – Regulations for Construction Projects.
 - .2 Provide all necessary guards and barriers to protect workers, property, and the public when performing hot work such as torching, cutting or coring. Protect all adjacent combustible materials.

- .3 Provide a "Fire Watch" for a minimum of 3 hours after each instance of discontinuing hot work.

END OF SECTION

1 DEFINITIONS

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 30 00.
- .2 Prior to commencing construction activities or delivery of materials to Site, submit Environmental Protection Plan for review and approval by Consultant. Environmental Protection Plan is to present comprehensive overview of known or potential environmental issues which must be addressed during construction.
- .3 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .4 Environmental protection plan: include:
 - .1 Name(s) of person(s) responsible for ensuring adherence to Environmental Protection Plan;
 - .2 Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from Site;
 - .3 Name(s) and qualifications of person(s) responsible for training site personnel;
 - .4 Descriptions of environmental protection personnel training program;
 - .5 Erosion and sediment control plan which identifies type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial and Municipal laws and regulations;

- .6 Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on Site;
- .7 Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plans include measures to minimize amount of mud transported onto paved public roads by vehicles or runoff;
- .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Plan to include measures for marking limits of use areas including methods for protection of features to be preserved within authorized work areas;
- .9 Spill Control Plan: including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance;
- .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris;
- .11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, do not become air borne and travel off-site;
- .12 Contaminant prevention plan that: identifies potentially hazardous substances to be used on Site; identifies intended actions to prevent introduction of such materials into air, water or ground; and details provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials;
- .13 Waste water management plan that identifies methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water and water used in flushing of lines;
- .14 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands;

.15 Pesticide treatment plan: to be included and updated, as required.

3 FIRES

.1 Fires and burning of rubbish on Site is strictly prohibited.

4 DISPOSAL OF WASTES

.1 Burying of rubbish or waste materials on Site is strictly prohibited.

.2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.

5 DRAINAGE & EROSION CONTROL

.1 Provide erosion and sediment control plan that identifies type and location of erosion and sediment controls to be provided. Plan: include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.

.2 Provide temporary drainage and pumping as necessary to keep excavations and Site, free from water.

.3 Do not pump water containing suspended materials into waterways, sewer or drainage systems.

.4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

.5 Provide and maintain temporary drainage and pumping as necessary to keep excavations and site free from excess water.

.6 Provide silt fencing at site perimeters and where required by local authorities to prevent contamination of adjoining properties from silt and water drainage.

6 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this Contract.

.2 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area, by providing temporary enclosures.

.3 Cover rubbish and wet down dry, dusty materials to prevent blowing dust and debris. Provide dust control for temporary roads.

7 NOTIFICATION

- .1 Consultant will notify Contractor in writing of observed non-compliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan. Contractor shall, after receipt of such notice, inform Consultant of proposed corrective action and take such action for approval by Consultant.

- .2 If no action is taken, the Consultant may issue a Stop Work Order until satisfactory corrective action has been taken. No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

END OF SECTION

1 GENERAL

- .1 Provide the project sign specified herein, not later than 14 days after commencement of the Work. Remove sign at completion of the project, or when necessitated by landscape work.

2 DESIGN AND APPROVAL

- .1 The sign design shall be as per design provided by the Consultant. Sign company to provide proofs to Consultant for approval prior to production of signage. Obtain Consultant's final approval of sign layout, prior to sign production.

3 MATERIALS

- .1 Sign Panels
 - .1 Plywood: minimum 19mm thick, Crezon-bonded plywood.
 - .2 Wood Posts & Framing: SPF (pressure preservative treated).
 - .3 Paint
 - .1 Primer: exterior alkyd enamel undercoat.
 - .2 Finish: exterior alkyd gloss enamel.
 - .4 Fasteners
 - .1 Wood screws: electroplated.
 - .2 Bolts: carriage bolts.
 - .3 Nails: spiral framing nails, hot-dip galvanized.
- .2 Sign Facing: UV resistant PVC sheet; colours as per sign design.

4 FABRICATION

- .1 Fabricate sign structure of SPF framing, bolted to posts. Provide cross-bracing as required. Set posts minimum 1220mm deep in compacted soil, or set in concrete.
- .2 Fabricate face panels of minimum 19mm thick plywood panels, screw fastened to framing.

5 PAINTING & GRAPHICS

- .1 Apply 1 coat primer and 2 coats finish paint to posts, framing, sign panel, and logo. Paint sign panel, framing and posts white, all surfaces.
- .2 Apply sign design as large size reprographic on vinyl adhered to sign panel.

6 INSTALLATION

- .1 Erect the sign where directed by the Consultant.

7 CONSULTANT SIGNAGE

- .1 In addition to the project identification sign, the Contractor will be responsible for displaying two 48x108 inch vinyl mesh banners attached with a zip-tie at each grommet as provided by the Consultant. The "design for the human spirit" banner is to appear to the right of the Lett logo banner.

END OF SECTION

- 1 PRODUCT OPTIONS
 - .1 Provide products specified under individual specification sections. Where Specification lists two or more products, or two or more manufacturers of the same product, the Contractor may select one of the listed products or manufacturers. Confirm selection of products and manufacturers when requested by the Consultant.
 - .2 When only one product or manufacturer is listed in the specifications, it is intended that only that product or manufacturer is acceptable.
- 2 PRODUCT SUBSTITUTION PROCEDURES
 - .1 Substitution Procedures During Construction
 - .1 Products may only be substituted during the Construction period for one or more of the following reasons:
 - .1 Insolvency of the product manufacturer.
 - .2 Inability of the manufacturer to provide the product(s) in the timeframe required to maintain the construction schedule.
 - .3 Product specified has been discontinued.
 - .4 Substitution proposed offers better performance than that specified, at no additional cost.
 - .5 Substitution offers equivalent performance to that specified, at a reduced cost to the Owner (reduction in Contract Price).
 - .2 Items 1.2, and 1.3 will require a letter from the manufacturer, confirming their inability to provide the products specified, or inability to meet the schedule.
 - .3 Items 1.4, and 1.5 will be at the discretion of the Owner.
- 3 AVAILABILITY
 - .1 Immediately upon signing Contract, review Product delivery requirements, and identify lead times for supply of all Products. If lead times in supply of Products may affect the Construction Schedule, notify the Consultant in order that appropriate action may be authorized in ample time to prevent delay in performance of the Work.
 - .2 The Contractor shall order Products and materials in a timely fashion so as to ensure that delivery of such Products and materials shall coincide with the Construction Schedule. Failure of the Contractor or their Subcontractors to order Products and materials in a timely fashion, shall not be cause for substitution in accordance with the criteria set out under Article 2 – Product Substitution Procedures.
 - .3 In the event of failure to notify the Consultant of Product delivery problems at the commencement of the Work, and should it appear that the Work may be delayed for such reason, the Consultant reserves the right to substitute more readily available Products of similar character of their choosing, at no increase in Contract Price.
- 4 REFERENCE STANDARDS
 - .1 Within the specifications, reference standards are identified. Conform to these standards, in whole or part, as specifically requested.

- .2 If there is question as to whether any product or system is in conformance with applicable standards, the Consultant reserves the right to have such products or systems tested to prove or disprove conformance.
 - .3 The cost for such testing will be born by the Owner in the event of conformance with Contract Documents or by the Contractor in the event of non-conformance.
 - .4 Conform to latest date of issue of referenced standards in effect on date of submission of bids, except where a specific date of issue is specifically noted.
- 5 **PRODUCT TRANSPORTATION & DELIVERY**
- .1 Transportation and delivery costs of Products required in the performance of the Work, are included in the Contract Price.
 - .2 Transportation and delivery costs of Products supplied by the Owner will be paid for by the Owner. Unload, handle, and store such Products on site.
 - .3 Products must be appropriately crated, skidded, boxed, shrink-wrapped, or otherwise packaged to protect such products from damage during shipment. Products which arrive at the site in a damaged condition must be rejected and returned to the supplier/manufacturer for immediate replacement.
 - .4 Advise the Owner 30 days in advance of anticipated delivery dates for materials and equipment supplied by the Owner.
- 6 **PRODUCT STORAGE, HANDLING AND PROTECTION**
- .1 Handle and store Products in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions.
 - .2 Store packaged or bundled Products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in the Work.
 - .3 Store products subject to damage from weather in weatherproof enclosures.
 - .4 Store cementitious products clear of earth or concrete floors, and away from walls.
 - .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
 - .6 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

- .7 Store paints in a heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
 - .8 Remove and replace damaged Products at own expense and to the satisfaction of the Consultant.
- 7 MANUFACTURER'S INSTRUCTIONS
- .1 Unless otherwise indicated in the specifications, install or erect Products in accordance with manufacturer's printed instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.
 - .2 Notify Consultant in writing, of conflicts between the specifications and manufacturer's instructions, so that Consultant may establish correct course of action.
 - .3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes the Consultant to require removal, replacement where necessary, and re-installation at no increase in Contract Price.
- 8 FASTENINGS
- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
 - .2 Prevent electrolytic action between dissimilar metals and materials.
 - .3 Use non corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in the affected specification Section.
 - .4 Space anchors within limits of load limit or shear capacity and ensure that they provide positive permanent anchorage. Wood or any other organic material plugs are not acceptable.
 - .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
 - .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.
 - .7 Obtain Consultant's approval before using explosive actuated fastening devices.
- 9 QUALITY OF MATERIALS
- .1 Products, materials, equipment and articles (referred to as Products throughout the specifications) incorporated in the Work shall be new, not damaged or defective, and of the best quality (compatible with specifications) for the purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.

- .2 Products relying on uniformity of colour and pattern for appearance, such as resilient flooring, carpeting, fabrics, and vinyl wallcovering, shall be from one dye lot for the project. All products delivered to the site must be labeled as to dye lot, or production run number, as well as production date.
 - .3 Defective products, whenever identified prior to the completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is a precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.
 - .4 Should any dispute arise as to the quality or fitness of Products, the Consultant may request additional testing based upon the requirements of the Contract Documents, to confirm acceptability of products or materials. Refer to Article 10 - Defective Materials And Work, and Section 01 40 00.
 - .5 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item throughout the building.
 - .6 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.
- 10 DEFECTIVE MATERIALS AND WORK
- .1 Where evidence exists that defective work has occurred, or that work has been carried out incorporating defective products, the Consultant may have independent tests, inspections, or surveys performed in order to determine if work is defective.
 - .2 Tests, inspections, or surveys carried out under these circumstances will be made at the Contractor's expense in the event of defective work, or at the Owner's expense where work is in conformance. Where tests incorporate a number of samples, payment will be assessed, by the Consultant, based on the ratio of conforming to non-conforming results. This does not include re-testing of soil compaction during placement, where evidence exists of non-conformance with the Contract documents, but rather only if re-testing is called for after completion of compaction.
- 12 WARRANTIES & GUARANTEES
- .1 Warrant all products and labour forming part of the Work for the period specified in the Contract, unless otherwise specified herein.
 - .2 Warrant products and assemblies for the specified periods of time where in excess of the Contract Warranty, as specified within their respective sections.
 - .3 Guarantee aspects of the Work for the specified periods of time where in excess of the Contract Warranty, as specified within their respective sections.

- .4 Warranties and Guarantees shall commence at Date of Substantial Performance of the Contract as certified by the Consultant.
- .5 Warranties and Guarantees shall be original copies, printed on company letterhead, or on a standard company warranty certificate, bearing the name of the company.
- .6 Warranties and Guarantees shall indicate:
 - .1 Name of the Principal (the Manufacturer/Subcontractor),
 - .2 Name of the Obligee (the Owner),
 - .3 Name and address of Project,
 - .4 Commencement date (Date of Substantial Performance),
 - .5 Duration of warranty or guarantee,
 - .6 Clear statement of what is included, and what if any exclusions there are, and
 - .7 Signature of Principal's representative having signing authority.

END OF SECTION

- 1 EXAMINATION
 - .1 Acceptance of Conditions
 - .1 The General Contractor shall examine all existing or pre-determined conditions, prior to commencing work in that area, and report to the Consultant all conditions unacceptable for work to proceed. Commencement of work shall imply acceptance of conditions as is.
 - .2 Subcontractors shall examine all existing or pre-determined conditions affecting their portion of the Work, prior to commencing such work, and report to the Contractor all conditions unacceptable for work to proceed. Commencement of work shall imply acceptance of conditions as is.
- 2 PREPARATION
 - .1 Field Engineering
 - .1 Locate, confirm and protect control points prior to starting the Work. Preserve permanent reference points during construction.
 - .2 Establish reference lines and elevations. Locate and lay out by instrumentation.
 - .2 Records
 - .1 Maintain a complete, accurate log of control points and survey work as work progresses.
 - .2 On completion of foundations and major site improvements, prepare certified survey showing dimensions, locations, angles and elevations of foundation work.
- 3 CUTTING AND PATCHING
 - .1 Submit a written request in advance, for approval of cutting or alteration which affects:
 - .1 Structural integrity of any element of Project.
 - .2 Integrity of weather-exposed or moisture-resistant elements.
 - .3 Efficiency, maintenance, or safety of any operational element.
 - .4 Visual qualities of sight-exposed elements.
 - .5 Work of Owner or separate contractor.
 - .2 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
 - .3 After uncovering, inspect conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.
 - .4 Perform cutting, fitting and patching, including excavation and fill, to complete the Work. Perform work to avoid damage to other work.
 - .5 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
 - .6 Cut rigid materials using power saw or core drill. Pneumatic or impact tools not allowed.

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- .7 Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces. At penetration of fire-rated wall, ceiling, or floor construction, completely seal voids with fire stopping material, full thickness of construction element.
 - .8 Refinish surfaces to match adjacent finishes; for continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.
 - .9 Provide all openings greater than 200mm in non-structural elements of work for penetrations of mechanical and electrical work. Mechanical and Electrical Subcontractors shall provided all sleeves and locations for sleeves. The cost of all cutting and patching required by Mechanical and Electrical Subcontractors shall be paid for by those trades.
 - .10 Ensure that all cutting and patching work, including that paid for by Mechanical and Electrical Subcontractors, is properly performed by the respective trades skilled in that line of work. Restore work with new products in accordance with Contract Documents.
- 4 LOCATION OF EQUIPMENT AND FIXTURES
- .1 Location of mechanical and electrical equipment, fixtures and devices indicated or specified, are to be considered as approximate. Final location of such items will be determined on site, based on integration with structural and architectural elements, and as required by coordination with other trades. In the event of a conflict, final determination of location of these items rests with the Consultant.
 - .2 Prepare and submit for review by the Consultant, interference field drawings, to indicate relative position of various services and equipment, at the following locations as a minimum:
 - .1 Under all rooftop mechanical units.
 - .2 At locations of all major ductwork, piping, and conduit crossovers.
 - .3 Where ductwork passes under major structural elements.
 - .3 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
 - .4 Request a review of items by Consultant once rough-in is underway, prior to final installation, and obtain approval for actual locations.
- 5 EXISTING SERVICES
- .1 Where work involves the interruption of, or connection to existing services, carry out such work as directed by governing authorities, with minimum of disturbance to pedestrian and vehicular traffic.
 - .2 Before commencing work, establish location and extent of service lines in area of work and notify Consultant of findings.
 - .3 Submit schedule to, and obtain approval from Owner for any shutdown or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.

- .4 Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.
 - .5 Record locations of maintained, re-routed and abandoned service lines.
 - .6 Provide adequate bridging over trenches that cross sidewalks or roads to permit normal traffic where required by Consultant's Drawings.
- 6 ALTERATIONS, OR ADDITIONS TO EXISTING BUILDING
- .1 Execute work with least possible interference or disturbance to occupants, public and normal use of premises. Arrange with Owner to facilitate execution of work.
 - .2 Shutdowns or interruptions to existing building services shall occur only following written notification of dates and durations of interruptions, and appropriate sign-offs by the Owner indicating acceptance. Notifications must be submitted minimum 14 days prior to anticipated interruption.
- 7 PROTECTION OF WORK IN PROGRESS
- .1 Adequately protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Consultant, at no increase in Contract Price.
 - .2 Prevent overloading of any part of the building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated, without written approval of Consultant.
 - .3 Protect finished surfaces with overlays of protective materials such as Kraft paper, cardboard, or plywood, as required for individual applications to provide adequate protection.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section includes administrative and procedural requirements for the following:
 - .1 Salvaging nonhazardous demolition and construction waste.
 - .2 Recycling nonhazardous demolition and construction waste.
 - .3 Disposing of nonhazardous demolition and construction waste.

1.2 DEFINITIONS

- .1 Alternative Daily Cover (ADC): Cover material other than soil placed on the surface of a municipal solid waste landfill at the end of each operating day to control vectors, fires, odors, blowing litter, and scavenging.
- .2 Commingled Waste: Single-stream recycling of material waste, considered as one material waste stream unless diversion rates can be provided by the recycling facility for specific materials.
- .3 Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging. Hazardous materials are not included.
- .4 Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations. Hazardous materials are not included.
- .5 Disposal: Removal off-site of demolition and construction waste and subsequent deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- .6 Diversion: To remove, or have removed, from the site for recycling, reuse, salvage, or return of materials that might otherwise be sent to a landfill. Diversion from landfill does not include burning, incinerating, thermally destroying waste, or waste-to-energy processes.
- .7 Return: To send back reusable or unused products to vendors or manufacturers.
- .8 Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

- .9 Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- .10 Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.
- .11 Segregation: To place similar waste materials together for collection in a designated site area, trash bin, or roll-off container.
- .12 Waste: Waste includes salvageable, returnable, recyclable and reusable material as well as material sent to landfill or incineration facilities. Hazardous materials are not included.
- .13 Waste Management Plan: A project-specific plan for the collection, transportation, recycling, salvage, and disposal of waste generated at the construction site. The purpose of the plan is to ultimately reduce the amount of material that is disposed of in landfills or incineration facilities.
- .14 Waste Material Stream: A flow of materials from a job site into markets for building materials, comprised of a material category (or mixture of several material categories) combined with a diversion method. A material stream must constitute at least five percent (by weight or volume) of total diverted materials for the Project. Examples include source separated materials sent to specific recycling facilities, commingled waste sent to a mixed-waste recycling facility, deconstructed materials sent back to a manufacturer as part of a take-back program, or salvaged materials reused on site.
- .15 Waste-To-Energy: The conversion of non-recyclable waste materials into usable heat and/or fuel through a variety of processes such as combustion, not including the combustion of wood into wood-derived fuel.

1.3 PERFORMANCE REQUIREMENTS

- .1 Project Diversion Goals: The Owner has established a goal to achieve the following total end-of-Project waste diversion rates (by weight or volume) of total non-hazardous solid waste generated by the demolition and construction Work:
 - .1 Required: Minimum 80 percent diversion
 - .2 Target: 95 percent diversion
- .2 General: Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction

and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, as applicable to the Work:

1.4 ACTION SUBMITTALS

- .1 Waste Management Plan: Submit plan prior to mobilization on site.
 - .1 Waste generated by on-site workers, such as plastic and metal beverage containers.
 - .2 All fluorescent lamps, HID lamps, and mercury-containing thermostats removed from the site shall be recycled.
- .2 Alternative Daily Cover: Alternative Daily Cover (ADC) may not be included as diverted material used to meet Project diversion rate goals.
- .3 Waste Management Plan: The Contractor shall be responsible for the development and implementation of a Construction Waste Management Plan for the Project.
 - .1 Final Construction Waste Management Plan: The plan shall contain the following:
 - .1 Estimate of the total proposed jobsite waste to be generated, including types and quantities.
 - .2 Proposed alternatives to Landfilling: A list of each material proposed to be salvaged, reused, or recycled during the course of the Project, the proposed destination for each material, and the projected amount (by weight or CY)
 - .3 Materials handling procedures: A description of the means by which any waste materials identified in Performance Requirements above will be separated (either sorted on-site or commingled on-site and sorted off-site) and protected from contamination, and the means to be employed in recycling the above materials consistent with the requirements for acceptance by recycling processors to be utilized.
 - .4 If waste materials are sorted and separated on-site, include anticipated sizes and quantity of containers, container labeling, and location(s) on the Project site.
 - .5 List of documentation to be provided in Progress Reports.
 - .6 Identification of material streams, as defined in the Section.
 - .2 Prior to request for Substantial Completion, provide final approved Waste Management Plan and summary table indicating site-

separated waste, by diverted material type, that indicates the total percentage of construction waste diverted from landfill and the identified waste material streams.

1.5 INFORMATIONAL SUBMITTALS

- .1 Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit a monthly Waste Management Report including a current Waste Tracking Form. Contractor may use their own Waste Tracking Form format or a sample form can be provided upon request. Include the following information:
 - .1 Project title, name of company completing report, and dates of period covered by the report
 - .2 Report on the disposal of all jobsite waste, including:
 - .1 Recycled materials. For each material stream, provide the following:
 - .1 Amount (in tonnes or cubic metres)
 - .2 Dates removed from the jobsite
 - .3 Receiving Party
 - .2 Reused or salvaged materials. For each material stream, provide the following:
 - .1 Amount (in tonnes or cubic metres)
 - .2 Description of intended or actual use
 - .3 Market value of materials
 - .3 Landfilled materials. Provide the following:
 - .1 Amount (in tonnes or cubic metres)
 - .2 Dates removed from the jobsite
 - .3 Identity of the transfer station or landfill
 - .4 Gross total quantity of waste generated during the period.
 - .5 Include a breakdown of diverted waste for each of the identified waste material streams and major material categories as follows:
 - .1 Concrete
 - .2 Steel or Metals
 - .3 Wood
 - .4 Gypsum Wallboard

- .5 Crushed Asphalt
- .6 Masonry
- .7 Cardboard
- .8 Blue box
- .6 Provide the quantity of land clearing debris and excavation soil. Note that these categories do not qualify as diverted waste.
- .7 Provide the name and location of the recycling or disposal facility that accepted the material.
- .8 Provide the percentage of total diverted waste generated as a percentage of total waste for the current period and cumulative project-to-date.
- .3 Records:
 - .1 Legible copies of on-site logs, weight tickets and receipts. Receipts shall be from recycling, processing and/or disposal site operators who can legally accept the materials for the purpose of reuse, recycling or disposal.
 - .2 If mixed construction and demolition waste is sorted off-site, provide a letter from the processor stating that reported quantities will reflect actual project values, and not average percentage of mixed C&D waste they recycle. Subcontractor shall save such original documents (as above) for the life of the project plus seven (7) year(s).
 - .3 Records of salvaged materials donated to charitable organizations. Indicate whether organization is tax-exempt.
- .4 Waste Reduction Final Report: Submit final report prior to the final Application for Payment.
- .2 Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
 - .1 Exclude excavation soil, land clearing debris and hazardous material.
 - .2 Calculations may be performed using either weight or volume, but shall be done consistently throughout the duration of the Project. Where exact materials weights or volumes are not available, use the following Conversion Factors:

.1	Cardboard	59 kg/m ³
.2	Gypsum wallboard	297 kg/m ³
.3	Mixed waste	208 kg/m ³
.4	Rubble	831 kg/m ³
.5	Steel	593 kg/m ³
.6	Wood	178 kg/m ³

- .3 Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- .4 Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- .5 Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- .6 Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- .7 Records of Returns: Indicate receipt and acceptance by vendors or manufacturers who have accepted waste materials as part of their take-back programs. Include receipts.
- .8 Records of Commingled Waste: If mixed construction and/or demolition waste will be commingled on-site and separated, sorted, and diverted off-site, provide monthly summaries of diversion rates from Recycler/Processor based on one of the following:
 - .1 *Project-specific diversion rate based on actual measurement of each component waste material.* Note that visual inspection is not an acceptable method of evaluation for documenting this percentage.
 - .2 If Recycler/Processor provides facility-wide aggregated, annual averaged diversion rates in lieu of Project-specific diversion rates, provide documentation that the Recycler/Processor's method of recording and calculating these rates is regulated by a local or state government authority.
- .9 Qualification Data: For refrigerant recovery technician (if applicable).

- .10 Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.6 QUALITY ASSURANCE

- .1 Waste Management Coordinator Qualifications: Experienced, with a record of successful waste management coordination of projects with similar requirements.
- .2 Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- .3 Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- .4 Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - .1 Review and discuss waste management plan including responsibilities of waste management coordinator.
 - .2 Review requirements for documenting quantities of each type of waste and its disposition.
 - .3 Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - .4 Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - .5 Review waste management requirements for each trade.
- .5 Project Meetings: The Waste Management Plan and implementation shall be discussed at the following meetings:
 - .1 Pre-construction meeting.
 - .2 Regular job-site meetings.
 - .3 Sub-contractor job-site coordination meetings.

1.7 WASTE MANAGEMENT PLAN

- .1 General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- .2 Waste Identification: Indicate all anticipated types and quantities of demolition, site clearing, and construction waste generated by the Work, including identifying at least five (5) materials streams targeted for diversion on the Project. Include estimated quantities and assumptions for estimates.
- .3 Waste Reduction Work Plan: For each waste material stream, list the means of disposal and whether it will be diverted (salvaged, recycled, and/or reused) or sent to landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, identification or receiving facilities, and handling and transportation procedures.
 - .1 Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - .2 Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - .3 Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - .4 Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - .5 Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - .6 Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

- .7 Alternative Daily Cover: Include a statement affirming that alternative daily cover or other excluded materials were not included in calculations used to meet Project diversion rate goals.

1.8 PROJECT MEETINGS

- .1 Waste management plans and implementation shall be discussed at the following meetings:
 - .1 Pre-construction meeting
 - .2 Regular job-site meetings
 - .3 Subcontractor toolbox meetings

Part 2 PRODUCTS (Not Used)

Part 3 EXECUTION

3.1 PLAN IMPLEMENTATION

- .1 General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - .1 Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
 - .2 Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
 - .3 Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - .1 Distribute waste management plan to everyone concerned within three days of submittal return.
 - .2 Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
 - .4 Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

- .1 Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
- .2 Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.
- .5 Waste Management in Historic Zones or Areas: Hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by distance determined by the Architect or more.

3.2 SALVAGING DEMOLITION WASTE

- .1 Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 - .1 Clean salvaged items.
 - .2 Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - .3 Store items in a secure area until installation.
 - .4 Protect items from damage during transport and storage.
 - .5 Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- .2 Salvaged Items for Sale and Donation: Not permitted on Project site, unless otherwise indicated.
- .3 Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
 - .1 Salvage items indicated on the drawings.
 - .2 Clean salvaged items.
 - .3 Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.

- .4 Store items in a secure area until delivery to Owner.
- .5 Transport items to Owner's storage area off-site, designated by Owner.
- .6 Protect items from damage during transport and storage.
- .4 Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- .5 Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- .6 Plumbing Fixtures: Separate by type and size.
- .7 Lighting Fixtures: Separate lamps by type and protect from breakage.
- .8 Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- .1 General: Recycle paper and beverage containers used by on-site workers.
- .2 Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to the Contractor.
- .3 Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- .4 Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - .1 Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - .1 Inspect containers and bins for contamination and remove contaminated materials if found.

- .2 Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
- .3 Stockpile materials away from construction area. Do not store within drip line of remaining trees.
- .4 Store components off the ground and protect from the weather.
- .5 Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

- .1 Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- .2 Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
- .3 Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
- .4 Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- .5 Metals: Separate metals by type.
 - .1 Structural Steel: Stack members according to size, type of member, and length.
 - .2 Remove and dispose of bolts, nuts, washers, and other rough hardware.
- .6 Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
- .7 Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- .8 Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- .9 Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.

- .10 Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 - .1 Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- .11 Carpet Tile: Remove debris, trash, and adhesive.
 - .1 Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- .12 Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- .13 Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

- .1 Packaging:
 - .1 Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - .2 Polystyrene Packaging: Separate and bag materials.
 - .3 Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - .4 Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- .2 Wood Materials:
 - .1 Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - .2 Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- .3 Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
 - .1 Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.6 DISPOSAL OF WASTE

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

END OF SECTION

- 1 INSPECTION AND DECLARATION PROCEDURES
 - .1 Arrange for, conduct and document final inspections, close-out and commissioning at the completion of the Work in accordance with the procedures described in the General Conditions of the Contract, and OAA/OGCA Document 100 - 2018.

- 2 SUBSTANTIAL PERFORMANCE
 - .1 Contractor's Inspection
 - .1 Refer to OAA/OGCA Document 100 – STAGE 2.
 - .2 The Contractor and all Subcontractors shall conduct an inspection of the Work, to identify deficiencies, defects, unsatisfactory and unfinished work.
 - .3 Upon completion of this inspection, the Contractor shall prepare a list of all items of uncompleted and unsatisfactory work, and issue such list to all Subcontractors concerned. Submit copy of the list to the Consultant.
 - .4 The Contractor shall then have all Subcontractors make corrections as required to conform with the Contract Documents.
 - .5 Notify Consultant in writing that all corrections have been made. Request a Consultant's Inspection.
 - .2 Contractor's Application for Substantial Performance of the Work
 - .1 Refer to OAA/OGCA Document 100 – STAGE 3.
 - .2 When the Contractor has carried out the steps in Stage 2 of OAA/OGCA Document 100, and has determined that the requirements of the Contract have been substantially performed as defined by local Lien legislation, the Contractor shall make application for Substantial Performance of the Work.
 - .3 In addition to the requirements of OAA/OGCA Document 100, the following items shall accompany the Contractor's application for Substantial Performance. These items must be complete in all respects, and all verification certificates and reports having been submitted and approved by the Consultants:
 - .1 Completed Maintenance Manuals for all disciplines (No. of copies as specified in Section 01 78 00),
 - .2 As-Built Drawings for all disciplines (CAD drawings),
 - .3 Occupancy Permit (where required by Municipality),
 - .4 Air Balance Report (legible technicians worksheets are acceptable),

- .5 Gas fired appliances inspection,
 - .6 Plumbing Inspection,
 - .7 Domestic Water Quality Test Report,
 - .8 Sprinkler dry test verification letter stamped and signed by sprinkler design Engineer,
 - .9 Mechanical start-up reports (Boilers, HVAC Units, Chillers, Water Softeners, etc.),
 - .10 Fire Alarm verification (include legible technicians worksheets),
 - .11 Emergency Lighting verification,
 - .12 Electrical distribution system inspection,
 - .13 Hydro (ESA) Certificate, and
 - .14 Systems operations have been demonstrated to Owner's personnel.
- .3 Consultant's Inspection
- .1 The Consultants shall perform an inspection of the Work to assess the validity of the Contractors application, and shall identify in separate lists, unfinished work and deficiencies. Contractor shall arrange to correct work accordingly.
- .4 Certificate of Substantial Performance
- .1 Refer to OAA/OGCA Document 100 – STAGE 4.
 - .2 Should the Consultant concur with the Contractor's application for Substantial Performance, the Consultant shall notify the Contractor of approval of the application for Substantial Performance and issue a Certificate of Substantial Performance.
 - .3 The Contractor shall publish a copy of the Certificate of Substantial Performance in a construction trade newspaper, and shall provide the Consultant with proof of the date of publication.
- 3 LIEN PERIOD AND RELEASE OF BASIC HOLDBACK
- .1 Refer to OAA/OGCA Document 100 – STAGE 5.
 - .2 Commencement of Lien Periods
 - .1 The day following the date of publication of Certificate of Substantial Performance shall be the date of commencement of the Lien Period prior to release of basic holdback, unless required otherwise by lien statute of the Place of the Work.
 - .2 When the Contractor has carried out the required steps in Stages 3 and 4 of OAA/OGCA Document 100, the Contractor may make

application for Release of Basic Holdback for those affected Subcontracts.

- .3 The Consultant shall prepare Certificates for Payment for release of basic holdback, and promptly upon receipt of the necessary documentation, issue the Certificates for Payment to the Owner.

4 CONTRACT COMPLETION

- .1 Refer to OAA/OGCA Document 100 – STAGE 6.
- .2 Following the issuance of the Certificate of Substantial Performance and prior to the Contractor's application for Final Payment and release of any monies retained as "Finishing Holdback", the Contractor shall continue to complete unfinished work and correct deficiencies.
- .3 When the Contractor is satisfied that the Contract is complete, the Contractor shall make a written request to the Consultant for a review and assessment of the Work.
- .4 Should further review by Consultants be required due to failure of the Work to comply with Contract Documents, the Owner will deduct amount of Consultant's compensation for reinspection services from monies owed to the Contractor.

5 PAYMENT OF FINISHING HOLDBACK

- .1 Refer to OAA/OGCA Document 100 – STAGE 7.
- .2 When the Contractor has completed the required steps in Stage 6 of OAA/OGCA Document 100, the Contractor may make application for Release of Finishing Holdback for those affected Subcontracts.

6 FINAL PAYMENT

- .1 Refer to OAA/OGCA Document 100 – STAGE 8.
- .2 When the Contractor has completed the required steps in Stage 6 of OAA/OGCA Document 100, the Contractor may make application for Final Payment for those affected Subcontracts.
- .3 If the Work is deemed to be complete, the Consultant will issue a Final Certificate for Payment.

END OF SECTION

- 1 OPERATION AND MAINTENANCE MANUALS
 - .1 General
 - .1 Prepare Operation and Maintenance Manual during the course of construction and have completed prior to Date of Substantial Performance.
 - .2 Submission
 - .1 Maintain electronic copy of the Operation and Maintenance Manual volume(s) for periodic review and comment, as requested by the Consultant during the course of construction.
 - .2 Submit final PDF copy of the final completed volume(s) with the application for Substantial Performance.
 - .3 Format
 - .1 Format – The O&M Manuals shall be submitted in searchable PDF format on two (2) USB flashdrives.
 - .2 Provide table of contents with hyperlinked items to each section of the manual.
 - .3 Provide drawings as required. Group drawings as to content and index for quick reference.
 - .4 Contents
 - .1 Table of Contents: provide title of Project, Date of submission and names:
 - .1 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties;
 - .2 Schedule of products and systems, indexed to content of volume.
 - .2 For each product or system: List names, addresses and telephone numbers of sub-contractors and suppliers, including local source of supplies and replacement parts.
 - .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
 - .4 Operation and Maintenance Manuals shall contain, as a minimum, the following information:
 - .1 List of Contents; cross-referenced to each Volume.
 - .2 Contact information for maintenance and repairs
 - .3 Warranty and guarantee certificates
 - .4 Equipment start-up and troubleshooting instructions

- .5 Equipment schematics & diagrams
- .6 Catalogue of all maintenance materials and quantities
- .7 Complete list of Contractor, Subcontractors and suppliers, indicating name, address, telephone & fax numbers, email addresses, name of contact person and description of work done.
- .8 Complete list of products used in the work, indicating product name and manufacturer for each listing.
- .9 Copy of Finish Hardware List, complete with all amendments and revisions, if applicable.
- .10 Schedule of paints and coatings. Include sufficient explanation to fully identify each surface with the applicable paint or coating used. Enclose copy of Colour Schedule.
- .11 All "reviewed" shop drawings.
- .12 Maintenance instructions for all finished surfaces.
- .13 Brochures and cuts of all equipment and fixtures.
- .14 Operating and maintenance instructions for all equipment.
- .15 All Warranties and Guarantees required by the Specifications.

.5 Refer to Mechanical Specifications for more specific mechanical data required beyond the description of this paragraph.

.6 Refer to Electrical Specifications for more specific electrical data required beyond the description of this paragraph.

.7 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.8 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

2 AS-BUILT DRAWINGS

- .1 Record information on a clean set of black line opaque drawings.
- .2 Maintain as-built drawings on site and update as construction progresses. Allow periodic review by Consultant as requested.
- .3 Record information concurrently with construction progress. Do not conceal work until required information is recorded.
- .4 Contract drawings and shop drawings: legibly mark each item to record actual construction, including:

- .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
-
- .5 Contractor shall submit to the Consultant to enter as-built information from marked-up drawings to a digital format of AutoCAD (latest version) on CD-ROM. Information to be entered on layers to Owner's standard.
 - .6 Submit marked-up hardcopy to the Consultant who will transfer updated to the digital drawing file on application for Certificate of Substantial Performance.
- 3 CERTIFIED SITE PLAN
- .1 Upon completion of foundation work, submit four copies and one digital (CAD) copy of a survey of the final disposition of the building from a qualified Ontario Land Surveyor certifying that all parts of the building are located in accordance with the requirements of the Contract Documents.
 - .2 The surveyor shall verify and certify additional lines and levels of any part of the work if deemed necessary by the Consultant. Deviations from Drawings shall be reported to the Consultant in writing with 24 hours of detection.
 - .3 On completion of the work and before application for Substantial Performance, submit to the Consultant six copies of the same survey submitted after completion of foundation work but supplemented by the same surveyor to show outline of paved areas, final finished grades throughout site and location of buried services. Any deviations from Contract Documents shall be noted.
- 4 EQUIPMENT AND SYSTEMS
- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
 - .3 Include installed colour coded wiring diagrams.
 - .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
 - .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - .6 Provide servicing and lubrication schedule, and list of lubricants required.
 - .7 Include manufacturer's printed operation and maintenance instructions.
 - .8 Include sequence of operation by controls manufacturer.
 - .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 - .10 Provide installed control diagrams by controls manufacturer.
 - .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
 - .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
 - .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 - .14 Include all test and balancing reports
 - .15 Additional requirements: as specified in individual specification sections.
- 5 MATERIALS AND FINISHES
- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
 - .3 Moisture protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
 - .4 Additional Requirements: as specified in individual specifications sections.
- 6 MAINTENANCE MATERIALS, SPARE PARTS & TOOLS
- .1 Provide spare parts in quantities specified in individual specification sections. Provide identical items to those installed in the Work.
 - .2 Provide maintenance materials in quantities specified in individual specification sections. Provide identical items of same manufacturer, dye lot or production run as items in the Work.
 - .3 Provide special tools in quantities specified in individual specification sections, and tag items identifying their function and equipment or products to which they are associated.
 - .4 Receive and catalogue all items. Check inventory and include approved listings in Operations and Maintenance Manual.
 - .5 Obtain receipts for delivered products and submit prior to Substantial Performance.
 - .6 Quality
 - .1 Spare parts, maintenance materials and special tools provided shall be new, not damaged or defective, and of the same quality and manufacture as products provided in the Work.
 - .2 If requested, furnish evidence as to type, source and quality of Products provided.
 - .3 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
 - .7 Delivery, Storage, And Handling
 - .1 Deliver all materials required as maintenance materials, spare parts or special tools, to the site, include shipping costs, and store as directed.

- .2 Store spare parts, maintenance materials and special tools in a manner to prevent damage, or deterioration.
- .3 Store in original and undamaged containers with manufacturer's seals or labels intact.
- .4 Store materials subject to damage from severe climatic changes in a climate-controlled, weatherproof enclosure.
- .5 Store paints and freezable materials in a moderately heated and ventilated room.

7 PHOTOGRAPHIC DOCUMENTATION

- .1 Provide all final photographic documentation on USB Flashdrive as specified in Section 01 32 33.

8 WARRANTIES AND BONDS

- .1 Separate each warranty or bond with index tab keyed to Table of Contents listing.
- .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.
- .4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.
- .5 Verify that documents are in proper form, contain full information, and are signed under corporate seal by persons having signing authority. Co-execute submittals when required.
- .6 Retain warranties and bonds until time specified for submittal.

9 EXTENDED WARRANTIES

- .1 Manufacturers shall furnish extended warranties as specified herein.
- .2 Extended warranties shall provide the Owner with the same rights as the original Contract warranty.
- .3 All Work performed under an Extended Warranty shall be subject to the same warranty as the original Contract warranty, and such warranty shall remain in effect for the greater period of time of:

- .1 The remaining period of the Extended Warranty.
- .2 Minimum one (1) year from the completion of such Extended Warranty Work.

- .4 The following is a list of extended warranties required under this Contract:
 - .1 Section 06 41 00 . Architectural Woodwork..... 2 yrs.
 - .2 Section 06 61 16 . Solid Surfacing 10 yrs.
 - .3 Section 07 52 16 . Modified Bituminous Roofing (material/installation) 10/2 yrs.
 - .4 Section 07 62 13 . Sheet Metal Flashing and Trim (finish). 40/30 yrs.
 - .5 Section 07 84 00 . Firestopping 3 yrs.
 - .6 Section 07 92 00 . Joint Sealants 3 yrs.
 - .7 Section 08 36 13 . Sectional Doors 2 yrs.
 - .8 Section 08 36 13.29 Exterior Bi-Folding Sectional Doors 2 yrs.
 - .9 Section 08 71 00 . Door Hardware Various
 - .10 Section 08 44 13 . Glazed Aluminum Curtain Walls 2 yrs.
 - .11 Section 08 51 13 . Aluminum Windows 2 yrs.
 - .12 Section 08 80 00 . Glazing (SGU/Coatings) 10/10 yrs.
 - .13 Section 08 90 00 . Louvers and Vents (finish) 40/30 yrs.
 - .14 Section 09 30 13 . Tiling (mortar and grout) 5 yrs.
 - .15 Section 09 30 13 . Exterior Tiling (mortar and grout) 5 yrs.
 - .16 Section 09 65 16 . Resilient Sheet Flooring 5 yrs.
 - .17 Section 09 65 22 . Resilient Sheet Sports Flooring 2/10 yrs.
 - .18 Section 09 68 13 . Tile Carpet 2/10 yrs.
 - .19 Section 09 91 13 . Exterior Painting 2 yrs.
 - .20 Section 09 91 16 . Interior Painting 2 yrs.
 - .21 Section 10 11 16 . Markerboards 10 yrs.
 - .22 Section 10 26 00 . Wall and Door Protection 5 yrs.
 - .23 Section 10 28 13 . Washroom Accessories (mirrors) 15 yrs.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Requirements for the curing and finishing of concrete floors and slabs.

1.3 RELATED SECTIONS

- .1 Polished Concrete Floor Finish Section 03 35 43

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/application shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .3 Documentation
 - .1 If requested by the Construction Manager, submit documentation to support the competency of firms and personnel.

1.5 PROTECTION

- .1 Keep traffic which would affect or disturb the curing procedures off the finished surfaces for a period of 7 days minimum the minimum period of cure time specified for the concrete mix proposed by the Subcontractor and concrete supplier and as reviewed and approved by the Construction Manager.
- .2 Protect exposed concrete finishes against damage.
- .3 Protect floors which are to receive applied coatings and finishes against contamination by oil, paint or other deleterious materials.
- .4 Protect items set into floors from damage and ensure that alignment is not disturbed.

2 PRODUCTS

2.1 MATERIALS

- .1 Curing membrane: Laminated waterproof paper consisting of laminations of kraft paper and water resistant materials capable of retaining the moisture in the concrete and tough enough to remain intact for the specified curing time.
- .2 Curing and sealing compound: to ASTM C309, Type 1, Class B.
- .3 Filler for exposed and concealed control joints: Load bearing, epoxy-urethane filler, 'Loadflex' by Sika Canada Ltd. <http://www.can.sika.com/> or other approved manufacture.

3 EXECUTION

3.1 QUALITY OF WORK

- .1 General
 - .1 Comply with the requirements of section 01 60 00.
 - .2 Comply with the requirements of CAN/CSA A23.1, except where greater requirements are specified herein.
 - .3 Comply with requirements of section 03 30 00, as applicable, and except where greater requirements are specified herein.
 - .4 Ensure surfaces are free of trowel marks and wash-boarding.
 - .5 Use compatible curing compounds, additives, admixtures, sealers and hardeners.
 - .6 Do not sprinkle dry cement or dry cement and sand mixture over concrete surfaces.
 - .7 Curing methods and materials shall be compatible with subsequent

applied finishes.

.2 Tolerances

- .1 Completed surfaces shall not vary more than 6mm in 3000mm from dead level except where slopes, and slopes to drains are required.

3.2 FINISHING

.1 Control Joints

- .1 Provide sawcut control joints to a depth of 1/4 of slab thickness in concrete slabs and toppings, located on column centre lines, unless closer spacing is indicated.
- .2 Fill control joints with epoxy type filler.
- .3 Rake out dirt in joints with an appropriate tool. Blow dirt out of joints with compressed air. Clean the floor surface by vacuuming with industrial type vacuum cleaner.
- .4 Apply filler full depth of joint in accordance with manufacturer's instructions, using the recommended application method except at electrostatic dissipation flooring.
- .5 Keep joints clean

.2 Moist/Wet Curing

- .1 All new concrete shall be wet cured where scheduled as such, as follows:

.1 Curing Procedure: All interior concrete slabs shall be protected from premature drying for a minimum of five days, as required in ACI 301, using moisture-retaining cover. Previously used cover material that is clean, in good condition, and free of tears can be reused. Cover concrete surfaces with moisture-retaining cover, placed in widest practical width with sides and ends lapped at least 75mm and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Remove curing cover and allow concrete to air dry for at least twelve (12) hours prior to applying liquid densifier/sealer.

.1 Acceptable Moisture-Retaining Cover:

- .1 "Transguard EG" by Reef Industries
- .2 "Hydrasorb 2" by Firstline Corp.
- .3 "UltraCure NCF" by McDonald Technology Group

.3 Curing and Sealing Compounds

- .1 Apply curing and sealing compounds in accordance with manufacturer's directions and as required to properly cure and seal the surfaces.

- .2 Apply curing compounds immediately after final finishing.

- .4 Levelling and Floating
 - .1 Strike off concrete after it is placed, level and flush and then level and consolidate with a wooden Darby or bullfloat. Complete levelling and consolidation before free moisture (bleeding) rises to surface.
 - .2 When concrete has stiffened sufficiently to sustain foot pressure and after removing free bleed water, float concrete with hand or power float.

- .5 Steel Trowel Finish
 - .1 After floating, trowel surface with steel hand or float trowel keeping blade flat at first and raising blade angle a little more on subsequent passes. Leave surface smooth, dense, of fine uniform texture without a swirl.

- .6 Slip Resistant Swirl Finish
 - .1 During final trowelling, impart a slightly rough and textured surface to the concrete by spin trowelling, moving the trowel in a "swirling" or circular motion in such a way as to produce a spin trowelled (swirled) texture or pattern on the surface.

- .7 Broom Finish for Slip Resistance
 - .1 After steel trowelling, lightly broom the surface with a bristle push broom to obtain a fine even texture finish.

3.3 SCHEDULE

- .1 Following curing methods and finishes to be applied to corresponding surfaces:

SURFACE	CURING METHOD	CONCRETE FINISH
Exposed concrete floors and toppings and mechanical and electrical bases	curing and sealing compound	steel trowel
Concrete to receive resilient flooring	curing and sealing compound	steel trowel Class A to CSA A23.1
Concrete to receive ceramic tile applied using thin-set bed or adhesive methods	Wet cure (refer to 3.2.3)	steel trowel Class A to CSA A23.1

Concrete to receive ceramic tile, brick/stone/precast concrete paving and flooring applied over mortar bed system; and to receive concrete topping	Wet cure (refer to 3.2.3)	wood float Class B to CSA A23.1
Concrete to receive special flooring, seamless flooring and similar, thin, fluid applied finishes including paint	moist cure/ Wet cure (refer to 3.2.3)	steel trowel Class A to CSA A23.1
Concrete to receive carpet	curing and sealing compound	steel trowel Class A to CSA A23.1
Concrete to receive roofing and waterproofing membranes except hot rubberized asphalt	Wet cure (refer to 3.2.3)	steel trowel finish Class B to CSA A23.1
Concrete to receive hot rubberized asphalt membranes	curing and sealing compound	wood float finish Class A to CSA A23.1
Exposed concrete stair treads and landings	curing and sealing compound	steel trowel
Concrete to receive cementitious waterproofing	Wet cure (refer to 3.2.3)	wood float
Concrete to receive water repellent coatings	Wet cure (refer to 3.2.3)	fine textured float finish
Exterior concrete paving	curing and sealing compound	Wood float finish with tooled edges and joints. Broom finish across ramped areas.

- .2 Should the Construction Manager elect to use a cure and seal cure method in lieu of where moist/wet cure specified, the cost of blast tracking the resultant surface to make it suitable to accept the applied finish shall be borne by the Construction Manager.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Applying sealer and hardener, and polishing concrete to specified finish level.

1.3 REFERENCES

- .1 ASTM-C779; Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces
- .2 ASTM G23; Ultraviolet Light & Water Spray
- .3 ASTM C805; Impact Strength
- .4 ACI 302. 1R; Guide for Concrete Floor and Slab Construction

1.4 SUBMITTALS

- .1 Comply with provisions of Section 01 30 00.
- .2 Product Data
 - .1 Submit special concrete finishes manufacturer's specifications and test data.
 - .2 Submit special concrete finishes describing product to be provided, giving manufacturer's name and product name for the specified material proposed to be provided under this section.

- .3 Submit special concrete finishes manufacturer's recommended installation procedures; which when approved by the Consultant, will become the basis for accepting or rejecting actual installation procedures used on the work.
 - .4 Submit special concrete finishes technical data sheet giving descriptive data, curing time, and application requirements.
 - .5 Submit special concrete finishes manufacturer's Material Safety Data Sheet (MSDS) and other safety requirements.
 - .6 Follow all special concrete finishes published manufacturer's installation instructions.
- .3 Samples
 - .1 Submit samples of finishes, indicating levels of texture and sheen for approval by the Consultant.
 - .4 Test Reports:
 - .1 Provide certified test reports, prepared by an independent testing laboratory, confirming compliance with specified performance criteria.
- 1.5 QUALITY ASSURANCE
- .1 Installer Qualifications:
 - .1 Use an experienced installer and adequate number of skilled workers thoroughly trained and experienced in the necessary craft.
 - .2 The special concrete finish manufacturer shall certify applicator.
 - .3 Applicator shall be familiar with the specified requirements and the methods needed for proper performance of work of this section.
 - .2 Manufacturer's Certification:
 - .1 Provide letter of certification from concrete finish manufacturer stating that installer is certified applicator of special concrete finishes, and is familiar with proper procedures and installation requirements required by the manufacturer.
 - .3 Mock-ups:
 - .1 Apply mock-ups of each type finish, to demonstrate typical joints, surface finish, color variation (if any), and standard of workmanship.
 - .2 Build mock-ups approximately 50 square feet in the location indicated or if not indicated, as directed by the Consultant.
 - .3 Notify Consultant seven days in advance of dates and times when mock-ups will be constructed.

- .4 Obtain from the Consultant approval of mock-ups before starting construction.
 - .5 If the Consultant determines that mock-ups do not meet requirements, demolish and remove them from the site and cast others until mock-ups are approved.
 - .6 Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work.
 - .7 Approved mock-ups may become part of the completed work if undisturbed at time of substantial completion.
- .4 Protection
- .1 No satisfactory chemical or cleaning procedure is available to remove petroleum stains from concrete surface. Prevention is essential.
 - .2 All hydraulic powered equipment must be diapered to avoid staining of the concrete.
 - .3 No trade will park vehicles on the inside slab. If necessary to complete their scope of work, drop cloths will be placed under vehicles at all times.
 - .4 No pipe cutting machine will be used on the inside floor slab.
 - .5 Steel will not be placed on interior slab to avoid rust staining.
 - .6 Acids and acidic detergents will not come into contact with slab.
 - .7 All trades informed that the slab must be protected at all times.
- .5 Pre-Installation Conference:
- .1 Conduct conference at project site to comply with Division 01.
- 1.6 DELIVERY, STORAGE AND HANDLING
- .1 Deliver materials in original containers, with seal's unbroken, bearing manufacturer labels indicating brand name and directions for storage.
 - .2 Dispense special concrete finish material from factory numbered and sealed containers. Maintain record of container numbers.
- 1.7 PROJECT CONDITIONS
- .1 Environmental Limitations:
 - .1 Comply with manufacturers written instructions for substrate temperature and moisture content, ambient temperature and

- humidity, ventilation, and other conditions affecting topping performance.
 - .2 Concrete Floor Flatness rating recommended at least 40, where possible.
 - .3 Concrete Floor Levelness rating recommended at least 30, where possible.
 - .4 Concrete must be cured a minimum of 45 days or as directed by the manufacturer before application of Retro Plate can begin.
-
- .2 Application of Retro-Plate shall take place 10 days prior to installation of equipment and substantial completion, thus providing a complete, uninhibited concrete slab for application.
 - .3 Close areas to traffic during floor application and after application, for time period recommended in writing by manufacturer.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 Advanced Floor Products, Inc., Provo, Utah (801-812-3420)

2.2 MATERIALS

- .1 Hardening/Sealing Agent
 - .1 Retro-Plate 99, by Advanced Floor Products, Inc.;;
 - .1 Abrasion Resistance: ASTM C779 – Up to 400% increase in abrasion resistance.
 - .2 Impact Strength: ASTM C805 – Up to 21% increase impact strength.
 - .3 Ultra Violet Light and Water Spray: ASTM G23-81 – No adverse effect to ultra violet and water spray.
 - .4 Reflectivity: Up to 30% increase in reflectivity.
 - .5 Finish: grinding and polishing to 1500 grit.

2.3 ACCESSORIES

- .1 Neutralizing Agent: Tri-sodium Phosphate
- .2 Water: Potable

3 EXECUTION

3.1 ACCEPTABLE INSTALLERS

- .1 Sentinel, 410 Industrial Rd., London, ON, or approved equivalent.

3.2 SURFACE CONDITIONS

- .1 Examine substrate, with installer present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.
- .2 Verify that base slab meet finish and surface profile requirements in Project Conditions above.
- .3 Prior to application, verify that floor surfaces are free of construction latents.

3.3 APPLICATION

- .1 Start any of the floor finish applications in presence of manufacturer's technical representative.
- .2 Sealing, Hardening and Polishing of Concrete Surface
 - .1 Concrete must be in place a minimum of 45 days or as directed by the manufacturer before application can begin.
 - .2 Application is to take place at least 10 days prior to racking and other in-store accessory installation, thus providing a complete, uninhibited concrete slab for application
 - .3 Only a certified applicator shall apply Retro-Plate 99. Applicable procedures must be followed as recommended by the product manufacturer and as required to match approved test sample.
 - .4 Achieve waterproofing, hardening, dust-proofing, and abrasion resistance of the surface without changing the natural appearance of the concrete, except for the sheen.
 - .5 Polish to sheen level to match approved sample.

3.4 WORKMANSHIP AND CLEANING

- .1 The premises shall be kept clean and free of debris at all times.
- .2 Remove spatter from adjoining surfaces, as necessary.
- .3 Repair damages to surface caused by cleaning operations.
- .4 Remove debris from jobsite. Dispose of materials in separate, closed containers in accordance with local regulations.

3.5 PROTECTION

- .1 Protect finished work until fully cured in accordance with manufacturer's recommendations.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide applied thin veneer clay brick masonry veneers as indicated, and including:
 - .1 Clay brick veneer.
 - .2 Mortar.
 - .3 Insulation Panels & fasteners
 - .4 Support system
 - .5 Air & Moisture Barriers
 - .6 Associated installation materials.

1.3 REFERENCES

- .1 CSA A179; Mortar and Grout for Unit Masonry.
- .2 CAN3-A370; Connectors for Masonry.
- .3 CAN/ULC-S102; Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .4 CAN/ULC-S114; Determination of Non-combustibility of Building Materials.
- .5 CAN/ULC-S701; Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .6 CAN/ULC-S770; Standard for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulation Foams.

1.4 SUBMITTALS

- .1 Product Data
 - .1 Submit product data in accordance with Section 01 33 23.
- .2 Samples

- .1 Submit duplicate sample panels of each colour and type of material, in accordance with Section 01 33 23.13.
- .3 Test Reports
 - .1 Submit laboratory test reports certifying compliance of mortar ingredients with specification requirements, in accordance with Section 01 33 23.
- 1.5 QUALITY ASSURANCE
 - .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
 - .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.6 MOCK-UP
 - .1 Construct mock-up in accordance with Section 01 33 23.
 - .2 Construct a 1220mm x 1220mm sample panel of veneer masonry, laid in specified mortar, and include all reinforcement, flashing, and accessories as required to represent typical wall construction. Approved sample panel may form part of final wall.
- 1.7 PRODUCT DELIVERY, STORAGE & HANDLING
 - .1 Deliver materials to job site in dry condition. Keep materials dry until use except where wetting is specified.

- .2 Store under waterproof cover on pallets or plank platforms, held off ground by means of plank or timber skids.
- 1.8 PROJECT CONDITIONS
 - .1 Maintain materials and ambient air temperature to minimum 4°C prior to, during, and for 48 hours after installation. Protect materials from moisture and freezing prior to, during, and for 48 hours after installation.
 - .2 Prohibit construction work on opposite side of wall during installation, and for 48 hours after installation.
- 1.9 PROTECTION
 - .1 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides, sufficient to protect walls from wind-driven rain, until masonry work is completed and protected by flashings or other permanent construction.
 - .2 Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.
- 1.10 EXTENDED WARRANTY
 - .1 The Subcontractor warrants the work of this Section to be in accordance with the Contract Documents and free from faults and defects in materials and workmanship for a period of fifteen (15) years from Date of Substantial Performance.
 - .2 The manufacturer of adhesives, liquid air and water barrier, mortars, pointing mortars and other installation materials shall provide a written Fifteen (15) year warranty against defects in materials and manufacture, which covers materials and labour.

2 PRODUCTS

2.1 MATERIALS

- .1 Applied Clay Brick
 - .1 Ultra Premium Series Clay Brick Units, by King Klinker USA, Sparta WI (supplied by KreitMaker, 122 Davenport Road, Toronto ON 416.423.9531), or approved equivalent;
 - .1 Thin Veneer Units Made from Clay or Shale: to ASTM C1088, Grade Exterior; Type TBS; brick are formed, fired and then cut to 1/2" (or 5/8") thickness as required; special shapes as indicated; and as follows:
 - .1 Colour: as selected by the Consultant
 - .2 Modular Size (2-1/4" x 7-5/8")
 - .3 Texture: sanded smooth, type 2 standard.
 - .2 Mortar: Latex-Portland cement mortar in accordance with ANSI A118.4.
 - .3 Panel Fasteners
 - .1 Wood Fasteners:

- .1 Stud Screws: Concealor Self Drill Screws with Pancake Head and Tri-Seal Coated ProGUARD®DP fasteners;
 - .1 Diameter: DP#1 - 5/8"(16mm)
 - .2 Length: to suit insulation thickness and stud spacing.
- .2 Concrete or Masonry Fasteners:
 - .1 Concrete Masonry, Poured Concrete, or Masonry Screws: Sentry Plus Five Screws with Truss Head and Epoxy Coated ProGUARD®DP fasteners;
 - .1 Length: to suit insulation thickness.
- .3 Screw Spacing: Engineer of Record to select the screw spacing based on the worst-case scenario based on three requirements: supported panels, unsupported panels and wind pressure.
- .4 Latex-Portland Cement Mortar: for leveling beds and scratch/plaster coats, to meet the following physical requirements:
 - .1 Compressive Strength (ANSI A118.4 Modified): >4000 psi (27.6 MPa)
 - .2 Water Absorption (ANSI A118.6): ≤ 5%
 - .3 Service Rating (TCA/ASTM C627): Extra Heavy
 - .4 Smoke & Flame Contribution (ASTM E84 Modified): 0
 - .5 Total VOC Content: < 0.05 mg/m³
 - .6 Acceptable Products:
 - .1 LATICRETE Premium Mortar Bed, or an approved equivalent.
- .5 Latex Portland Cement Mortar: weather, frost, shock resistant, non-flammable to meet the following physical requirements:
 - .1 Compressive strength (ANSI A118.4): >2000 psi (13.8 MPa)
 - .2 Bond strength (ANSI A118.4): >400 psi (2.8 MPa)
 - .3 Smoke & Flame Contribution (ASTM E84 Modified): 0
 - .4 Total VOC Content: < 0.05 mg/m³
 - .5 Acceptable Products:
 - .1 LATICRETE MVIS Thin Brick Mortar, or an approved equivalent.
- .6 Latex Portland Cement Pointing Mortar / Grout: weather, frost and shock resistant, to meet the following physical requirements:
 - .1 Compressive Strength (ASTM C91): >3000 psi (20.7 MPa)
 - .2 Smoke & Flame Contribution (ASTM E84 Modified): 0
 - .3 Total VOC Content: < 0.05 mg/m³
 - .4 Acceptable Products:
 - .1 LATICRETE MVIS Pointing Mortar, or an approved equivalent.
- .7 Expansion and Control Joint Sealant: one component, neutral cure, exterior grade silicone sealant, supplemented with sand to simulate mortar, to meet the following requirements:
 - .1 Tensile Strength (ASTM C794): 280 psi (1.9 MPa)
 - .2 Hardness (ASTM D751; Shore A): 25 (colored sealant) /15 (clear sealant)

- .3 Weather Resistance (QUV Weather-ometer): 10000 hours (no change)
- .4 Colour: to match mortar.
- .5 Acceptable Products:
 - .1 LATICRETE Latasil™, or an approved equivalent.

- .8 Spot Bonding Epoxy Adhesive: for installing adhered masonry veneer, brick and stone over vertical and overhead surfaces shall be high strength, high temperature resistant, non-sag and shall meet the following physical requirements:
 - .1 Thermal Shock Resistance (ANSI A118.3):>1000 psi (6.9 MPa)
 - .2 Water Absorption (ANSI A118.3): 0.1 %
 - .3 Compressive Strength (ANSI A118.3):>8300 psi (57.2 MPa)
 - .4 Shear Bond Strength (ANSI A118.3 Modified):>730 psi (5 MPa)
 - .5 Acceptable Products:
 - .1 LATAPOXY 310 Stone Adhesive (Standard or Rapid Grade), or an approved equivalent.

- .9 Substructure
 - .1 Vertical & Horizontal Girts:
 - .1 Vertical girts supporting panels are 1.2mm (18 gauge) thick, galvanized zinc-coated steel to ASTM A653 with Grade A coating Z275. Painted black.
 - .2 Preformed galvanized metal sheet, 1.2mm (18 gauge) thick, minimum base steel nominal thickness, notched or perforated for drainage.
 - .3 Girt locations as determined and approved by structural engineer, to align with modular panel fasteners spaced based on manufacturer's panel load data.
 - .4 Front fastened systems:
 - .1 Girts behind panels to be installed to allow proper ventilation.
 - .2 Preformed black galvanized steel girts to be used at inside and outside corners to ensure corners are straight and closed visually, and used at intermediary panel locations and where panels come together.
 - .3 Girts provided by Engineered Assemblies, or approved equivalent.
 - .5 Cavity behind panel: Minimum 25mm (1") of unrestricted space.
 - .6 Gap between panels: Minimum of 8mm (5/16") to allow for expansion and contraction.(Max12mm)
 - .7 EPDM Rubber Separation Strip: Designed and supplied by Engineered Assemblies or approved equivalent, to be installed between the panel and the vertical girt to allow movement between panel and support system, meeting the following:
 - .1 Shore "A" Hardness: ASTM D2240.
 - .2 Compression Set, 22h at 212°F (100°C): ASTM D395.
 - .3 Ozone Resistance, 100 mPa 100h @ 104°F (40°C) 20%
 - .4 Elongation: ASTM D1149.

- .5 Tensile Strength: ASTM D412.
- .6 Elongation at Rupture: ASTM D412.
- .7 Tear Strength: ASTM D624.
- .8 Brittleness Temperature at -40°F (-40°C): ASTM D746.
- .9 Flame Propagation, Option II; ASTM C1166.
- .8 Substructure to account for control joints of building to ensure a girt is not connected across the control joint.
- .9 Install panels across one set of vertical girts to ensure that expansion and contraction of the substrate is controlled within framing members.
- .2 Clip System: 38mm (1-1/2") wide, die cut aluminum extruded clip, adjustable to plumb structure, minimum 1.2mm (18 gauge) thick galvanized zinc-coated steel to ASTM A653. System to provide compliance to ASHRAE 90.1 and thermally broken façade requirements of the building code. Effective R Value to that provided on drawings.
 - .1 Adaptable horizontal or vertical framing members.
 - .2 Clip Depth:
 - .1 100mm (4")
 - .2 125mm (5")
 - .3 150mm (6")
 - .4 175mm(7")
 - .5 200mm(8")
 - .3 Vertical Clip Spacing:
 - .1 610mm (24")
 - .2 914mm (36")
 - .3 1220mm (48")
 - .4 Acceptable Products:
 - .1 EA RVRS TClip and Girt, by Engineered Assemblies (info@engineeredassemblies.com) or (905) 816-2218. Clip size to suit applications.
 - .2 Or approved equivalent.
- .3 Fasteners:
 - .1 Colour matched stainless steel, as per manufacturer's recommendations. No dissimilar materials allowed, in selection of fasteners.
 - .2 All holes are pre-drilled at same diameter.
- .4 Bird and Vent Screen:
 - .1 Continuous bird and vent screen located at top and bottom of panel system, where opening is minimum 25mm (1") wide, with minimum 50% free air flow, manufactured by Engineered Assemblies from perforated aluminum, painted black.
- .5 Flashings: Prefinished steel as specified in Section 07 62 00.

- .1 Flashings at edges, top and bottom of panel system as per architectural drawings.
- .10 Underlayment Membranes:
 - .1 Air Barrier & Transition Membranes: to Section 07 27 00.
- .11 Insulation: mineral wool to Section 07 21 13.
- .12 Sheathing Board: Cement Board to Section 09 21 16.

3 EXECUTION

3.1 QUALITY OF WORK

- .1 Build masonry plumb, level, and true to line, with vertical joints in alignment.
- .2 Perform masonry mortar work in accordance with CSA A179 except where specified otherwise.
- .3 Lay out coursing and bond to achieve correct coursing heights and continuity of bond above and below openings, with minimum of cutting.
- .4 Remove chipped, cracked and otherwise damaged units in exposed masonry and replace with undamaged units.

3.2 EXAMINATION

- .1 Do not begin installation until substrates have been properly prepared.
- .2 Verification of Conditions:
 - .1 Examine substrates to receive work and surrounding adjacent surfaces for conditions affecting installation. Coordinate with related sections to ensure proper dimensions are maintained.
 - .2 Verify site dimensions by accurate field measurements so that work will be accurately designed, fabricated and fitted to the structure.
 - .3 All penetrations through the façade for the work of other trades shall be fitted with a watertight sleeve. Verify flashings are in place, sealed with waterproof membrane and covered with building membranes.
 - .4 Maintain sheathing membrane integrity.
- .3 Notify Contractor in writing of any conditions that are not acceptable.
- .4 Proceed with installation after verification and correction of surface conditions acceptable to manufacturer.

3.3 INSTALLATION

- .1 Erect panel system in accordance with manufacturer's instructions.
- .2 Erect panels in straight lines, true, level and plumb. Maintain dimensions required by manufacturer for minimum distances from edge for holes and penetrations.

- .3 Space at top and bottom of each wall minimum 25mm (1"), as per manufacturer's details.
 - .4 Installation to allow for thermal expansion of the panel. Provide a minimum of 10mm (3/8") space between each panel on all four sides, allowing for expansion.
 - .5 Holes are pre-drilled as per manufacturer's written instructions, in locations recommended by panel manufacturer. Provide pre-drilled holes a minimum distance between 20mm and 38mm (13/16" and 1-1/2") from all edges of panel.
 - .6 Size of rivets as per manufacturer's written instructions. No other types of fasteners are approved. All exposed rivets shall be coated to match panel finish, as provided by the panel manufacturer.
 - .7 Install panels with joints centered over framing. Install all rivets straight to the panel and in a consistent manner.
 - .8 Do not install using damaged, warped or misaligned material.
 - .9 Where panels fit into accessories, allow room for expansion.
 - .10 Finished installation shall be properly secured, free of rattles, distortions, waviness, and protrusions, damaged or chipped components.
 - .11 Cut and flash wall penetrations with metal flashing.
 - .12 Install weather barrier membrane in accordance to manufacturer's instructions. No penetrations are to be left in installed membrane.
- 3.4 CLAY BRICK VENEER
- .1 Apply materials in accordance with manufacturer's written instructions.
 - .2 Apply base mortar and place units butted closely together leaving approximate 10mm joints. Plan work to minimize cutting of units. Press units firmly into place.
 - .3 When base mortar is set, fill all joints between tiles with veneer mortar, and tool all joints smooth.
 - .4 Clean excess mortar from surfaces, and do not allow mortar to set up on face of units. Point and tool joints before mortar has set. Clean and finish joints as per manufacturer's written instructions.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Masonry Procedures.
- .2 Mortar and Grout for Masonry.
- .3 Masonry Reinforcing & Connectors.
- .4 Masonry Accessories.
- .5 Plain Concrete Unit Masonry.

1.3 REFERENCES

- .1 CSA-A165 Series; CSA Standards on Concrete Masonry Units.
- .2 CSA-A179; Mortar and Grout for Unit Masonry.
- .3 CSA-A370; Connectors for Masonry.
- .4 CSA-A371; Masonry Construction for Buildings.
- .5 CSA-S304.1; Masonry Design for Buildings (Limit States Design).

1.4 SUBMITTALS

- .1 Source Quality Control
 - .1 Manufacturers of concrete masonry units must submit independent laboratory test reports performed within the twelve month period immediately prior to date of delivery of material, certifying compliance of masonry units and mortar components with specification requirements, in accordance with Section 01 30 00.
 - .2 All concrete masonry units supplied for this project must be from one supplier only.
 - .3 All Architectural masonry units supplied for this project must be from same production run for each type.

1.5 QUALITY ASSURANCE

.1 Manufacturer/Fabricator

.1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

.2 Installation/Application

.1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.

.3 Documentation

.1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.

.4 Pre-application Meeting

.1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:

.1 Contractor (Site Superintendent & Project Manager)

.2 Application Subcontractor (Site Foreman & Project Manager)

.3 Product Manufacturer and/or Distributor (Technical Representatives)

.4 Related Subcontractors whose work is affected by that of this Section.

1.6 DELIVERY, STORAGE & HANDLING

.1 Deliver materials to job site in dry condition. Keep materials dry until use except where wetting is specified.

.2 Deliver all masonry units cubed and banded on hardwood pallets, with polyethylene "shrink-wrap", or other non-staining covering. Prevent damage to units.

.3 Deliver mortar materials in original unbroken and undamaged packages with manufacturer's name and brand distinctly marked thereon, and upon delivery store in dry shed until used on work.

.4 Store or pile sand on a plank platform and protect from dirt and rubbish. Store mortar materials and sand in such a manner as to prevent deterioration or contamination by foreign materials.

.5 Lift skids with proper and sufficiently long slings or forks with protection to prevent damage to units. Protect edges and corners.

.6 Store masonry in a manner designed to prevent damage and staining of units.

- .7 Place polyethylene or other plastic film between wood and other finished surfaces of units when stored for extended periods of time.
 - .8 Cover stored units with protective enclosure if exposed to weather.
 - .9 Do not use salt or calcium-chloride to remove ice from masonry surfaces.
- 1.7 PROJECT CONDITIONS
- .1 Cold Weather Requirements
 - .1 Supplement Clause 5.16.2.1 of CSA-A371 with the following:
 - .1 Maintain mortar temperature between 5°C and 50°C for a minimum of 3 days after setting.
 - .2 Hot Weather Requirements
 - .1 Supplement Clause 5.16.4 of CSA-A371 with the following:
 - .1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
- 2 PRODUCTS**
- 2.1 MATERIALS
- .1 Use same suppliers of masonry units, accessory materials and source of aggregate for entire project.
 - .2 Portland cement: Type 10 to CSA-A5.
 - .3 Blended Cement: to CSA-A362.
 - .4 Aggregates: to CSA-A23.1.
 - .5 Hydrated Lime: to ASTM C207.
 - .6 Supplementary Cementing Materials: to CSA-A23.5.
- 2.2 CONCRETE MASONRY UNITS (CB)
- .1 The physical properties of the concrete masonry units at the time of delivery by the manufacturer to the site, shall conform to the requirements of Table 1 of CSA-A165.1, as classified herein. Test reports submitted to the Consultant by the manufacturer prior to delivery shall verify conformance, in order for material to be acceptable.
 - .2 Provide special shapes such as return corners, ashlar blocks, lintels, universal knock-outs, A-blocks, sash blocks, piers, bull-nosed blocks, etc., to perform masonry work with minimal cutting or breaking of masonry units.
 - .3 Standard Weight Concrete Masonry Units: to CSA-A165.1.
 - .1 Classification: H/15/A/M.
 - .2 Sizes:
 - .1 OCBA metric modular.

- .2 Imperial sizes to match existing PAC building.
 - .3 Thicknesses: as indicated on the drawings.
 - .4 Lightweight Concrete Masonry Units: to CSA-A165.1.
 - .1 Classification: H/15/D/M.
 - .2 Sizes:
 - .1 OCBA metric modular.
 - .2 Imperial sizes to match existing PAC building.
 - .3 Thicknesses: as indicated on the drawings.
 - .5 Solid Concrete Masonry Units: to CSA-A165.1.
 - .1 Classification: S/15/A/M.
 - .2 Size: OCBA metric modular.
 - .1 Thicknesses: as indicated on the drawings.
- 2.3 HORIZONTAL REINFORCEMENT
- .1 Horizontal reinforcement shall be sized to suit width of masonry in accordance with CSA-A371. Undersized or oversized reinforcing is not acceptable.
 - .2 Provide pre-manufactured "L" and "T" corner units. Crimped metal strap ties are not acceptable for connecting intersecting walls.
 - .3 Corrosion protection: to CSA-A370, hot-dip galvanized for metal ties and horizontal reinforcing in exterior walls.
 - .4 Single Wythe Masonry: Standard 3.66mm wire with hot-dip galvanized finish after fabrication to CSA-A371;
 - .1 Ladder Type:
 - .1 Blok-Lok® BL-10, by Blok-Lok Ltd.
 - .2 220 Ladder Mesh, by Hohmann & Barnard Inc.
 - .2 Truss type:
 - .1 Blok-Trus® BL-30, by Blok-Lok Ltd.
 - .2 120 Truss Mesh, by Hohmann & Barnard Inc.
 - .5 Double Wythe Masonry (no cavity): Standard 3.66mm wire, hot-dip galvanized finish after fabrication to CSA-A371;
 - .1 Block-Trus® BL32, by Blok Lok Ltd.
 - .2 140 Truss Twin Mesh, by Hohmann & Barnard Inc.
 - .6 Partition Stabilization: PTA 420 Partition Top Anchor, by Hohmann & Barnard Inc.
- 2.4 MORTAR AND GROUT
- .1 Use aggregate passing 1.18mm sieve where 6 mm thick joints are indicated, to CSA-A179.
 - .2 Mortar for foundation walls, manholes, sewers, pavements, walks, patios and other exterior masonry at or below grade and under joist and beam bearings and other locations noted on the structural drawings: Type "M" based on specifications of CSA-A179.

- .3 Mortar for interior concrete masonry and all load-bearing masonry above grade, including inner wythe of exterior cavity walls: Type "S" based on specifications of CSA-A179.
 - .4 Mortar Colour
 - .1 Interior Concrete Block: Natural.
 - .5 All mortar products for masonry work shall be batch plant mixed on site for quality control. No hand mixing will be permitted. Use Maxi-Mix or other similar batch plant silo system.
 - .6 Grout: for masonry shall be pre-mixed, high strength, non-shrink cementitious grout, to CSA-A179, with minimum compressive strength of 30MPa.
 - .7 All mortar products for masonry work shall be batch plant mixed on site for quality control. No hand mixing will be permitted. Use Maxi-Mix or other similar batch plant silo system.
- 2.5 ACCESSORIES
- .1 Control Joint Block Fillers: "Titewall" by Bloc-Lok Ltd., or "RS Series" by Hohmann & Barnard Inc.

3 EXECUTION

3.1 QUALITY OF WORK

- .1 Perform masonry work in accordance with CSA-A371, except where specified otherwise.
- .2 Build masonry plumb, level, and true to line, with vertical joints in alignment.
- .3 Perform masonry mortar and grout work in accordance with CSA-A179 except where specified otherwise.
- .4 Provide temporary bracing of all masonry walls until permanent bracing is installed.
- .5 Lay out coursing and bond to achieve correct coursing heights and continuity of bond above and below openings, with minimum of cutting.
- .6 Machine cut all exposed masonry units where adjusted in size.
- .7 Tolerances in notes to Article 5.3 of CSA-A371 apply.
- .8 Remove chipped, cracked, or otherwise damaged units and replace with new.

- .9 Coordinate work of this section with work of mechanical and electrical trades for conduit, piping, and other items built-in to masonry work. Masonry Subcontractor must cooperate with mechanical and electrical trades, for placement of such items within masonry walls.

3.2 LAYING CONCRETE MASONRY UNITS

- .1 Bond: Running Bond
- .2 Coursing Heights:
 - .1 Standard Block: 200mm for one 190mm high block + one joint.
- .3 Construct all masonry walls full height to underside of structure or deck above, unless otherwise shown. Leave 25mm void between top of wall and structure above. Fill void with 25x152mm mineral wool insulation. Where walls are fire separations, firestop to Section 07 84 00.
- .4 Set bearing plates for joists, beams, etc., at locations and elevations indicated, and grout into place.
- .5 Special Shapes
 - .1 Provide Universal Knock-out blocks for chases for piping and conduit.
 - .2 Provide A-Blocks for all vertical reinforcing locations.
 - .3 Provide Lintel blocks over all openings where steel lintels are not specified.
- .6 Provide lightweight block for all fire-rated applications, and all block exposed to view.
- .7 Provide standard weight block for all non-fire rated applications, where concealed.
- .8 Provide solid masonry units where required for mechanically fastening of blocking, furring or mechanically applied finishes.
- .9 Do not form chases in load-bearing walls less than 240mm thick. Do not form chases closer than 2m apart in any wall, unless otherwise shown.
- .10 Do not construct horizontal chases for piping or conduit unless other reasonable means of allowing for services are impossible. Where horizontal chases are required, construct chases using lintel blocks filled solid with concrete fill as specified.
- .11 Build in conduits as required without breaking bond.

3.3 JOINTING

- .1 Allow joints to set sufficiently to remove excess water;
 - .1 Concave Joints: tool with round jointer to provide smooth, compressed, uniformly concave joints, vertical and horizontal.
- .2 Remove all excess mortar from surface of masonry.

3.4 CONCRETE MASONRY LINTELS

- .1 Install reinforced concrete masonry lintels over all openings in masonry wider than 400mm where steel or reinforced concrete lintels are not indicated.
- .2 Reinforced concrete masonry lintels may be formed on the ground and lifted into place.
- .3 End bearing shall be not less than 200mm.
- .4 Maintain sufficient support for lintels until initial compressive strength of concrete fill is reached (min. 7 days).

3.5 VERTICAL REINFORCING

- .1 Refer to Section 03 20 00.
- .2 Place vertical reinforcement in cells of concrete unit masonry as detailed on the drawings. Provide A-Blocks where required to facilitate ease of placement.
- .3 Place vertical reinforcement accurately and secure against displacement by using ties or clips. Tack welding of reinforcement to secure in place will not be permitted.
- .4 Secure vertical reinforcement in walls using sufficient spacers on each face to maintain the requisite distance between reinforcement and wall face and so that vertical bars are plumb. Provide spreader bars spaced at 2m centres in both directions.
- .5 Place concrete fill in masonry unit cells, in maximum 2 course lifts. Vibrate to remove all air pockets.

3.6 HORIZONTAL REINFORCING

- .1 At all single and double wythe concrete masonry walls, install reinforcing at vertical intervals of 400mm maximum and lapped 152mm at each splice.
- .2 Provide reinforcement in the first, second and top bed joints at 200mm vertical spacing, every second joint thereafter.
- .3 Provide additional reinforcement immediately above lintel and below sill courses, extending 600mm beyond each jamb.
- .4 Provide masonry veneer ties at exterior cavity walls with CMU back-up, at vertical intervals of 400 mm maximum, and horizontal intervals of 600mm maximum.
- .5 Install insulation retainers at every veneer tie point.

3.7 LATERAL SUPPORT AND ANCHORAGE

- .1 Provide lateral support and anchorage in accordance with CAN3-S304, and as indicated on the drawings.

- .2 Where walls exceed the limits stated in CAN3-S304, provide partition stabilization anchors at top of masonry partitions for full length of wall at 1220mm o.c. maximum.
- 3.8 CONTROL JOINTS
- .1 Provide vertical control joints to CSA-A371, and as shown on the drawings.
 - .2 Width of control joints shall be 10mm.
 - .3 Horizontal reinforcing shall be continuous across control joints.
 - .4 Where not otherwise shown or detailed, the following minimum requirements for vertical control joints in unit masonry shall apply:
 - .1 Above all openings in masonry, extending from end point of lintel to top of masonry.
 - .2 At all structural column or pilaster locations.
 - .3 All locations where structural substrate changes.
 - .4 At all uninterrupted panels of masonry. Maximum panel width 7m.
 - .5 Within 1000mm each side of changes in direction of wall.
- 3.9 JOINING OF WORK
- .1 Where necessary to temporarily stop horizontal runs of masonry, and in building corners, step-back masonry diagonally to lowest course previously laid. Do not "tooth-in" new masonry. Fill in adjacent courses before heights of stepped masonry reach 1220mm.
- 3.10 SUPPORT OF LOADS
- .1 For all masonry under concentrated loads, where concrete fill is used in lieu of solid units, use minimum 15MPa concrete for width and depth equal to 3 times the length of bearing.
 - .2 Use grout to CSA-A179 where grout is used in lieu of solid units.
 - .3 Install building paper below voids to be filled with concrete. Keep paper 13mm back from faces of units.
- 3.11 FIELD QUALITY CONTROL
- .1 The work of this section is subject to inspection and testing as specified in Section 01 40 00. Allow for independent inspection by an Independent Testing Authority. Costs for inspection and testing will be paid by the Owner.
 - .2 Prior to commencement of construction, the masonry Subcontractor shall prepare and mix on-site, under supervision of the Consultant and the Inspection and Testing Authority, mortar samples to determine compliance with the specifications
 - .3 Tests of such samples shall determine a ratio-by-mass value or "control value" for mortar mixes.

- .4 Masonry Mortar shall be tested in accordance with CSA-A179; Mortar and Grout for Unit Masonry, supplemented as follows:
 - .1 Additional cubes shall be poured under on-site conditions for comparison with "ideal" samples.
- .5 Subsequent sample ratio tests taken during the course of construction shall not vary from the control value by more than 15%.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide light structural metal framing including:
 - .1 Structural metal studs,
 - .2 structural design,
 - .3 shop and site fabrication,
 - .4 welding and erection,
 - .5 installation of masonry veneer anchors, and
 - .6 construction review.

1.3 REFERENCE STANDARDS

- .1 CAN/CSA-G164; Hot Dip Galvanizing of Irregularly Shaped Articles.
- .2 CSA S16.1; Steel Structures for Buildings, Limit States Design.
- .3 CSA-S136; Cold Formed Steel Structural Members.
- .4 CSA-W47.1; Certification of Companies for Fusion welding of Steel Structures.
- .5 CSA-W55.3; Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .6 CSA-W59; Welded Steel Construction (Metal Arc Welding).
- .7 CSSBI-50M; Canadian Sheet Steel Building Institute, Lightweight Steel Framing Manual.
- .8 CAN/CGSB-1.181-99M; Ready-Mixed Organic Zinc-Rich Coating.

1.4 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 30 00.

-
- .2 Each shop drawing submitted shall bear the stamp and signature of a qualified Professional Engineer registered in the Place of the Work who has coverage of minimum \$1,000,000 liability insurance.
 - .3 Submit all necessary shop drawings, bearing the professional seal and signature of the Structural Steel Stud Subcontractor' Engineer, including design calculations for review by the Consultant. Shop drawings to include all necessary shop details and erection diagrams with;
 - .1 member sizes, locations, thickness (exclusive of coatings), metallic coatings and mechanical properties,
 - .2 connection details for attaching framing to itself and to the structure,
 - .3 dimensions, framing for window openings, requirements of related work and critical installation procedures,
 - .4 temporary bracing required for erection purposes,
 - .5 all design loads shown, and
 - .6 welds indicated by welding symbols as defined in CSA W59.
 - .4 Submit copies of engineering calculations and/or certified data verifying the capacity of members, connectors, connections, and the ability of assemblies to meet the design requirements, signed and sealed by the Structural Steel Stud Subcontractor's Engineer.
 - .5 Do not fabricate until submittals are reviewed and approved by Consultant.
 - .6 Submit copies of all field review reports to the Consultant in accordance with Section 01 40 00.
 - .7 Submit stress diagram or print-out of computer design indicating design load for each truss member. Indicate allowable load and stress increase.
 - .8 Provide certification that trusses meet requirements of CSA-S136.
 - .9 Indicate arrangements of webs or other members to accommodate ducts and other specialties.
 - .10 Show lifting points for storage, handling and erection.
 - .11 Show location of lateral bracing for compression members.

1.5 DESIGN CRITERIA

- .1 The Light Structural Metal Framing Subcontractor is responsible for the structural design and construction review of structural metal stud framing systems. These responsibilities shall be discharged by the Light Structural Metal Framing Subcontractor's Engineer.

- .2 Use Limit States Design Principles using factored loads and resistances, except that stud deflections and top track design and anchorages to be service loads and working stress design.
- .3 Refer to Structural drawings for loads. Load factors shall be in accordance with the Ontario Building Code.
- .4 Design bridging to prevent member rotation and member translation perpendicular to minor stud axis. Provide for secondary stress effects due to torsion between lines of bridging. Do not consider collateral sheathing to contribute to strength or stiffness.
- .5 Maximum deflections under specified loads shall conform to the following:
 - .1 Wall studs supporting material other than masonry: $L/360$.
 - .2 Walls studs supporting masonry: $L/720$.
- .6 Design components or assemblies to accommodate specified erection tolerances of the structure.
- .7 Spacing of members shall not exceed the following:
 - .1 Wall studs: 406mm.
- .8 Allow for movement of the structure. Design wind bearing stud end connections to accommodate floor/roof deflections such that studs are not loaded axially. Refer to structural drawings for magnitude of floor/roof deflections.
- .9 Connections between lightweight steel framing members shall be by bolts, welding or sheet metal screws.
- .10 Resistances for sheet metal screws shall be based on manufacturer's lowest bound test values multiplied by appropriate resistance factor, given in CSA S136.
- .11 Load bearing studs include:
 - .1 Wall studs subjected to lateral loads (no axial load other than self-weight and the weight of applied finishes),
 - .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 deflections.
- .12 Make allowances for increased loads and corresponding member resistance required around openings, including effects on the track and track to structure connections. The Structural Steel Stud Subcontractor is responsible to provide the entire exterior wall stud system, including any hot rolled structural steel sections required to complete the assembly, where structural steel studs are impractical.

1.6 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
 - .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.7 MOCK-UP
- .1 Construct a 4m long (full height) sample panel of exterior steel stud wall assembly in place.
 - .2 Mock-up will be reviewed for approval by the Consultant. If rejected, correct mock-up and request review by Consultant. If approved, mock-up may remain in place as part of the finished Work, and will serve as the minimum acceptable standard for work of this section.
- 2 PRODUCTS**
- 2.1 METAL FRAMING
- .1 Steel Stud Members: to CAN/CSA-S136, fabricated from zinc-coated steel, sizes as indicated. Minimum steel thickness of 1.22mm.
 - .2 Steel Stud Tracks: fabricated from same material and finish as steel studs, depth to suit.
 - .1 Bottom track: single piece.
 - .2 Top track: single piece or two-piece telescoping.
 - .3 Separator: neoprene, sized to suit.

- .3 Steel Bridging: fabricated from same material and finish as stud/truss members, 1.22mm minimum thickness.
- .4 Steel Angle Clips: fabricated from same material and finish as stud/truss members, 38 x 38mm x depth of member, 1.22mm minimum thickness.
- .5 Steel Tension Straps and Accessories: as recommended by manufacturer.
- .6 Screws: pan head, self-drilling, self-tapping, sheet metal screws, corrosion protected to minimum requirements of CSSBI. Length to suit.

3 EXECUTION

3.1 GENERAL

- .1 Perform work of this section in accordance with CSSBI 50M.
- .2 Perform welding in accordance with CSA W59.
- .3 Companies to be certified under 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.2 ERECTION

- .1 Erect components to requirements of reviewed shop drawings.
- .2 Anchor tracks securely to structure at 812mm o.c. maximum.
- .3 Erect studs plumb, aligned and securely attached with not less than two No. 8 screws or welded at each side of flange of top and bottom tracks.
- .4 Install 50mm minimum telescoping track at top of walls where required to accommodate vertical deflection. Nest top track into deflection channel a minimum of 31mm and a maximum of 40mm. Do not fasten tracks together. Stagger joints and install neoprene separator.
- .5 Install studs at not more than 50mm from abutting walls, openings, and each side of corners and terminations with dissimilar materials.
- .6 Brace steel studs with horizontal internal bridging at 1220mm maximum. Fasten bridging to 1.22mm steel clips fastened to steel studs with 4 - #8 screws or by welding.
- .7 Frame openings in stud walls to adequately carry loads by use of additional framing members and bracing as detailed on shop drawings.
- .8 Touch up welds with coat of zinc rich primer.

3.3 ERECTION TOLERANCES

- .1 Plumb: not to exceed 1/500th of member length.
- .2 Camber: not to exceed 1/1000th of member length.

.3 Spacing: not more than 3mm from design spacing.

3.4 CUTOUTS

.1 Maximum size of cutouts for services as follows:

Member Depth	Across Member Depth	Along Member Length	Centre to Centre Spacing
92mm	40mm max	105mm max.	610mm min.
102mm	40mm max.	105mm max.	610mm min.
152mm	65mm max.	115mm max.	610mm min.

.2 Limit distance from centreline of last unreinforced cutout to end of member to less than 300mm.

3.5 FIELD QUALITY CONTROL

.1 Inspection and testing of materials and workmanship will be carried out by testing laboratory.

.2 Costs of tests will be paid under cash allowance. Refer to Section 01 21 00.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide all miscellaneous metal fabrications. Specific items herein do not represent a full and complete inventory of all miscellaneous metals items. The Contractor is responsible for providing all items as specified herein and as shown on the drawings.

1.3 REFERENCE STANDARDS

- .1 ASTM-A53/A53M; Specification for Pipe, Steel Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .2 ASTM-A325; Specification for High Strength Bolts for Structural Steel Joints.
- .3 ASTM-A563; Specification for Carbon and Alloy Steel Nuts.
- .4 ASTM-C1107; Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).
- .5 Aluminum Association (AA); DAF-45, Designation System for Aluminum Finishes.
- .6 ASTM B209; Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .7 ASTM B221M; Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

- .8 CSA-W47.1; Certification of Companies for Fusion Welding of Steel Structures.
- .9 CSA-W55.3); Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .10 CSA-W59; Welded Steel Construction (Metal Arc Welding).
- .11 CSA-G40.20/G40.21; General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steels.
- .12 CAN/CSA-G164; Hot Dip Galvanizing of Irregular Shaped Articles.
- .13 CAN/CGSB-1.40; Primer, Structural Steel, Oil Alkyd Type.
- .14 CAN/CGSB-1.181; Ready-Mixed Organic Zinc-Rich Coating.

1.4 PERFORMANCE REQUIREMENTS

- .1 Guard assemblies shall be designed, fabricated, and installed to conform to the requirements of the Ontario Building Code.

1.5 QUALITY ASSURANCE

- .1 Manufacture & Fabrication
 - .1 Companies to be certified under Division 1 or 2.1 of CSA-W47.1 for fusion welding, and CSA-W55.3 for resistance welding. Provide certification that all welded joints are certified by Canadian Welding Bureau.
 - .2 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)

- .3 Product Manufacturer and/or Distributor (Technical Representatives)
- .4 Related Subcontractors whose work is affected by that of this Section.

1.6 MOCK-UPS

- .1 Where mock-ups involve components of other trades coordinate construction of mock-up with those trades.
- .2 Railing & Guard Assemblies
 - .1 Construct mock-up of railing and guard assemblies including railings, brackets, anchors and finishes. Mock-ups shall include one corner and one capped end.
 - .2 Construct mock-up of reasonable length to form part of the construction, and minimum 1m long with minimum 2 brackets. Locate where directed by Consultant.
- .3 Mock-ups will be reviewed for approval by the Consultant. If rejected, correct mock-up and request re-review by Consultant. If approved, mock-up may become part of the finished work, and will serve as the minimum acceptable standard for this work.

1.7 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 30 00.
 - .2 Each shop drawing submitted shall bear the stamp and signature of a qualified Professional Engineer registered in the Place of the Work who has coverage of minimum \$1,000,000 liability insurance.
 - .3 Submit all necessary shop drawings, bearing the professional seal and signature of the Subcontractor' Engineer, including design calculations for review by the Consultant. Shop drawings to include all necessary shop details and erection diagrams with;
 - .1 member sizes, locations, thickness (exclusive of coatings), metallic coatings and mechanical properties,
 - .2 connection details for attaching framing to itself and to the structure,
 - .3 dimensions, requirements of related work, and critical installation procedures,
 - .4 temporary bracing required for erection purposes,
 - .5 design loads, and
 - .6 welds indicated by welding symbols as defined in CSA-W59.
 - .4 Submit copies of engineering calculations and/or certified data verifying the capacity of members, connectors, connections, and the

ability of assemblies to meet the design requirements, signed and sealed by the Subcontractor's Engineer.

- .5 Do not fabricate until submittals are reviewed and approved by Consultant.
- .2 Samples
 - .1 Submit samples in accordance with Section 01 30 00.
 - .2 Submit samples of aluminum fabrications in shapes as detailed and in colours selected, for review by the Consultant.

2 PRODUCTS

2.1 MATERIALS

- .1 Aluminum Members: Alcan 6063-T54 alloy and temper.
 - .1 Extruded Aluminum: to ASTM B221.
 - .2 Sheet & Plate Aluminum: ASTM B209.
- .2 Steel Sections And Plates: to CAN/CSA-G40.21, grade 300W.
- .3 Steel Pipe: to ASTM-A53/A53M, standard weight, yield strength 240 MPa, black or galvanized finish.
- .4 Welding Materials: to CSA-W59.
- .5 Bolts And Nuts: to ASTM-A325 and ASTM-A563.
- .6 Galvanizing: hot dipped galvanizing with minimum zinc coating in accordance with Table 1 of CAN/CSA-G164.
- .7 Shop Primer: oil-alkyd type, to CAN/CGSB-1.40.
- .8 Galvanized Primer: zinc-rich, ready mix to CAN/CGSB-1.181.
- .9 Grout: to ASTM-1107, non-shrink, non-metallic, flowable, minimum compressive strength of 30Mpa after 24 hours, pull-out strength 7.9 Mpa;
 - .1 M-Bed® Superflow by Sika Canada Inc., or
 - .2 Sealtight® CG-86™ by W.R. Meadows of Canada.

2.2 FABRICATION

- .1 Refer to drawings and details for items not specified herein.

- .2 Fabricate work square, true, straight, and accurate to required size, with joints closely fitted and properly secured.
- .3 Use self-tapping shake-proof countersunk, Robertson flat head, screws on items requiring assembly by screws. Use screws for interior metal work. Use welded connections for exterior metal work unless otherwise detailed or approved by Consultant.
- .4 Where possible, fit and shop assemble work, ready for erection.
- .5 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.
- .6 Miscellaneous Angles, Plates and Lintels Not Provided by Structural: Steel angles, prime painted in sizes indicated. Provide 150mm minimum bearing at ends. Weld back-to-back angles to profiles where indicated. Fabricate and install all aluminum items to have concealed fasteners. No exposed fasteners permitted.
- .7 Bench Supports: Fabricate from Type 304 stainless steel sections, to shapes indicated on the drawings, drilled as required for anchors. Refer to drawings for locations.
- .8 OH Door Jamb Supports: Fabricate from hot-dip galvanized steel sections from floor to top of opening, with welded steel jamb anchors as required.
- .9 All interior metal fabrications where exposed to view, are to be considered as "furnishings" and shall be fabricated, finished and installed as such.
 - .1 Fabrication: fabricate all items using best quality materials. Fit and finish shall be "furniture grade". Make all welds even and uniform. Grind and sand all welds smooth. Remove all grinder, and other fabrication marks. Remove all burrs, sharp edges and corners. Fabricate assemblies in largest practical sizes that will allow for factory finishing where specified.
 - .2 Finishing: factory finish all aluminum assemblies prior to shipping. Provide protective wrappings on all factory finished items prior to shipping, and adequately crate/package items for shipping.
 - .3 Installation: All factory-finished items shall be bolted or screw-fastened in place. No on-site welding of factory-finished items is acceptable. Steel items shall be installed using welds, bolts or screws, sufficient to provide proper support. All screws shall be countersunk.

2.3 FINISHES

.1 Steel

.1 Shop Painting

.1 Apply one shop coat of alkyd steel primer to metal items, with exception of galvanized or concrete encased items.

.2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7°C.

.3 Clean surfaces to be field welded; do not paint.

.2 Field Painting

.1 Refer to Sections 09 91 13, 09 91 16, and 09 97 13.23 for field finishing.

.2 Aluminum

.1 Fluoropolymer Paint: Kynar 500® based, factory-applied, thermosetting, 2-coat fluoropolymer paint system, to AAMA 605.2, consisting of a prime coat, and colour top coat. Colours as selected by Consultant.

.1 Duranar (2 Coat System), by PPG Canada Inc.

.2 Fluoropon (2 Coat System), by The Valspar Corporation.

3 EXECUTION

3.2 ERECTION

.1 Install all miscellaneous metals items specified herein and detailed on the drawings.

.2 Do welding work in accordance with CSA-W59 unless specified otherwise.

.3 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.4 Provide suitable means of anchorage acceptable to Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.5 Exposed fastening devices to match finish and be compatible with material through which they pass.

.6 Provide components for building-in by other sections in accordance with shop drawings and schedule.

- .7 Make field connections with high tensile bolts, or weld.
- .8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection, with primer.
- .9 Touch-up galvanized surfaces burned by field welding with zinc rich primer.

3.3 VANITY BRACKETS

- .1 Install vanity brackets at unsupported ends of vanities, and between sinks in all multiple sink vanity locations. Bolt to wall assembly using hex-head, high-strength bolts. Ensure wood backing is in place prior to installation.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide metal stairs and balustrades;
 - .1 Steel Grate stairs.

1.3 REFERENCE STANDARDS

- .1 ASTM-A53/A53M; Specification for Pipe, Steel Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .2 ASTM-A325; Specification for High Strength Bolts for Structural Steel Joints.
- .3 ASTM-A563; Specification for Carbon and Alloy Steel Nuts.
- .4 CSA-W47.1; Certification of Companies for Fusion Welding of Steel Structures.
- .5 CSA-W55.3; Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .6 CSA-W59; Welded Steel Construction (Metal Arc Welding).
- .7 CSA-G40.20/G40.21; General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steels.
- .8 CAN/CSA-G164; Hot Dip Galvanizing of Irregular Shaped Articles.
- .9 CAN/CGSB-1.40; Primer, Structural Steel, Oil Alkyd Type.
- .10 CAN/CGSB-1.181; Ready-Mixed Organic Zinc-Rich Coating.

1.4 DESIGN CRITERIA

- .1 Design metal stair, balustrade and landing construction and connections to OBC vertical and horizontal live load requirements.

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- .2 Detail and fabricate stairs to NAAM Metal Stairs Manual.
- 1.5 **QUALITY ASSURANCE**
- .1 **Manufacture & Fabrication**
 - .1 Companies to be certified under Division 1 or 2.1 of CSA-W47.1 for fusion welding, and CSA-W55.3 for resistance welding. Provide certification that all welded joints are certified by Canadian Welding Bureau.
 - .2 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .2 **Installation/Application**
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .3 **Documentation**
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
 - .4 **Pre-application Meeting**
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.6 **SUBMITTALS**
- .1 **Shop Drawings**
 - .1 Submit shop drawings in accordance with Section 01 30 00.
 - .2 Each shop drawing submitted shall bear the stamp and signature of a qualified Professional Engineer registered in the Place of the Work who has coverage of minimum \$1,000,000 liability insurance.
 - .3 Submit all necessary shop drawings, bearing the professional seal and signature of the Subcontractor' Engineer, including design calculations for review by the Consultant. Shop drawings to include all necessary shop details and erection diagrams with;

- .1 member sizes, locations, thickness (exclusive of coatings), metallic coatings and mechanical properties,
 - .2 connection details for attaching framing to itself and to the structure,
 - .3 dimensions, requirements of related work, and critical installation procedures,
 - .4 temporary bracing required for erection purposes,
 - .5 design loads, and
 - .6 welds indicated by welding symbols as defined in CSA-W59.
- .4 Submit copies of engineering calculations and/or certified data verifying the capacity of members, connectors, connections, and the ability of assemblies to meet the design requirements, signed and sealed by the Subcontractor's Engineer.
- .5 Do not fabricate until submittals are reviewed and approved by Consultant.

2 PRODUCTS

2.1 MATERIALS

- .1 Steel Sections And Plates: to CAN/CSA-G40.21, grade 300W.
- .2 Steel Pipe: to ASTM-A53/A53M, standard weight, yield strength 240 MPa, black or galvanized finish.
- .3 Welding materials: to CSA W59.
- .4 High strength bolts: to ASTM A325.
- .5 Shop Primer: oil-alkyd type, to CAN/CGSB-1.40.
- .6 Galvanized Primer: zinc-rich, ready mix to CAN/CGSB-1.181.

2.2 FABRICATION

- .1 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.
- .2 Accurately form connections with exposed faces flush; mitres and joints tight. Make risers of equal height.
- .3 Grind or file exposed welds and steel sections smooth.
- .4 Shop-fabricate stairs in sections as large and complete as practicable.
- .5 All metal stair and handrail fabrications are to be considered as "furnishings" and shall be fabricated, finished and installed as such.

- .1 Fabrication: fabricate all items using best quality materials. Fit and finish shall be "furniture grade". Make all welds even and uniform. Grind and sand all welds smooth. Remove all grinder, and other fabrication marks. Remove all burrs, sharp edges and corners. Fabricate assemblies in largest practical sizes that will allow for factory finishing where specified.
- .2 Finishing: factory-finish all aluminum assemblies prior to shipping. Provide protective wrappings on all factory-finished items prior to shipping, and adequately crate/package items for shipping.
- .3 Installation: All factory-finished items shall be bolted or screw-fastened in place. No on-site welding of factory-finished items is acceptable. Steel items shall be installed using welds, bolts or screws, sufficient to provide proper support. All screws shall be countersunk.

2.3 STEEL GRATE STAIRS

- .1 Fabricate stairs with open riser construction.
- .2 Form landings and treads from steel grate. Secure landings, treads to stringers.
- .3 Form stringers from continuous structural steel channels.
- .4 Provide clip angles for fastening of furring channels, where applied finish is indicated for underside of stairs and landings.
- .5 Extend stringers around mid landings to form steel base.
- .6 Close ends of stringers where exposed.
- .7 Painted Steel Balustrades
 - .1 Fabricate all stair handrails and supports from steel sections welded and made smooth, as detailed.
 - .2 Construct posts, pickets, stringers, and all other stair members of prime painted steel, to sizes and configurations as detailed on the drawings.

2.4 SHOP PAINTING

- .1 Clean surfaces in accordance with Steel Structures Painting Council SSPC - SP2-63.
- .2 Apply one coat of shop primer.
- .3 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, grease, do not paint when temperature is below 7°C.
- .4 Do not paint surfaces to be field welded.

3 EXECUTION

3.1 INSTALLATION OF STAIRS

- .1 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs to structure.
- .2 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .3 Perform welding in accordance with CSA W59.
- .4 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provide all material, labour, equipment and services and perform all operations necessary or required for the work of this section, including fabrication and installation of prefabricated access ladders and roof barrier guards.

1.3 REFERENCE STANDARDS

- .1 ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .2 ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .3 OSHA 1910.27 – Fixed Ladders.
- .4 OBC Requirements for Guards.

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified

herein, warranty requirements, and in accordance with generally accepted, industry best practices.

- .3 Documentation
 - .1 If requested, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.5 PERFORMANCE REQUIREMENTS
 - .1 Stair Treads: capable of withstanding a concentrated (1000 pound)454 kg load without deformation
 - .2 Handrail: capable of withstanding a load of (200 pounds)90 kg applied in any direction at any point on the rail.
- 1.6 SUBMITTALS
 - .1 Shop Drawings
 - .1 Submit shop drawings indicating dimensions, materials, construction and fabrication, installation details, and finishes, in accordance with Section 01 30 00.
- 1.7 SEQUENCING
 - .1 Coordinate start and installation of steel alternating treads with all other related and adjacent work.
 - .2 Do not start installation until weather conditions and remaining construction operations will not damage stair installation.
- 2 PRODUCTS**
 - 2.1 ACCEPTABLE MANUFACTURER
 - .1 Skyline Group, Perth ON, 877.417.6336
 - .2 O'Keefe's Inc., Brisbane CA, 888.653.3333
 - 2.2 ACCESS LADDER
 - .1 Aluminum: Basis of Design: Series 7001 KATT Modular Ladder System by Skyline Group;
 - .1 Overall ladder width – 605mm
 - .2 Distance between vertical side rails – 525mm
 - .3 Rung diameter – 50 x 35mm (profiled)
 - .4 Rung spacing – 300mm
 - .5 Vertical side rail extension above landing surface – 900 to 1100mm

- .6 Minimum clearance behind ladder – 200mm
 - .7 Maximum distance between rest platforms – 6.0M
 - .8 Weight
 - .1 Rung sections – 2.9kg/M (ex. fixing brackets and fixings)
 - .2 Cage sections – 8.3 kg/M
 - .9 Provide lockable hinged security panel.
- 2.3 LOW ROOF GUARD (Alternative Price No. 1)
- .1 Aluminum: Basis of Design: Modular 5001 Hinged RoofBarrier Guardrail System by Skyline Group;
 - .1 Components:
 - .1 Tube: A-787 1.66” 11 gauge G90 galvanized steel tube.
 - .2 Rails and Posts: A-787 1.66” 11 gauge G90 galvanized steel tube.
 - .3 Clamp fittings: Elbows, Crossovers, Wall flanges, Tees, Couplings, fluorocarbon finish or hot dipped galvanized.
 - .4 Weighted Bases: Steel base plates are 5/8” thick and supplied with powder-coated finish, upright receivers and a .” thick rubber protection mat on underside of the component.
 - .5 Fasteners: All Fasteners shall be 304 or 305 stainless steel.
 - .2 Assembly:
 - .1 Fit and shop-assemble components in largest practical sizes for delivery to site.
 - .2 Upright tops shall be plugged with weather and light resistant material where required.
 - .3 Assemble components with joints tightly fitted and secured with set screws tightened to 20 ft.lbs. of torque.
 - .4 Accurately form components to suit installation.
- 2.4 FINISHES
- .1 Aluminum: Mill (natural) finish.
- 3 EXECUTION**
- 3.1 INSTALLATION:
- .1 Access Ladder Installation
 - .1 Install ladder secure fastened to the structure in accordance with manufacturer's instructions.
 - .2 Roof Barrier Installation:
 - .1 For all connections with clamp fittings, each set screw is to be tightened to 20 ft.lbs. of torque.
 - .2 Placement of uprights and weighted base plates to meet manufacturer specifications as stated in the RoofBarrier Installation Instructions.
 - .3 Terminate the run as stated in the RoofBarrier Installation Instructions.
- 3.2 CLEANING

- .1 Remove all installation materials and equipment. Leave work area clean and free of debris.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide rough carpentry work, including but not limited to, the following:
 - .1 Miscellaneous furring and blocking,
 - .2 Exterior plywood sheathing,
 - .3 Sheathing, nailers, and curbs for roofing,
 - .4 Electrical mounting boards, and
 - .5 Rough blocking in walls for support of wall-mounted items.

1.3 REFERENCES

- .1 CSA-B111; Wire Nails, Spikes and Staples.
- .2 CAN/CSA-G164; Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CSA-O80 Series; CSA Standards for Wood Preservation.
- .4 CSA-O86-01; Engineering Design in Wood (Working Stress Design).
- .5 CSA-O112 Series; CSA Standards for Wood Adhesives.
- .6 CSA-O121; Douglas Fir Plywood.
- .7 CAN/CSA-O141; Softwood Lumber.
- .8 CSA-O151; Canadian Softwood Plywood.
- .9 CAN/CSA-O325.0; Construction Sheathing.
- .10 CAN/ULC-S102; Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .11 National Lumber Grades Authority (NLGA) Special Products Standard for Finger joined Structural Lumber.
- .12 National Lumber Grades Authority (NLGA) Standard Grading Rules for Canadian Lumber.

1.4 QUALITY ASSURANCE

- .1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: by grade mark in accordance with applicable CSA standards.

2 PRODUCTS

2.1 LUMBER MATERIAL

- .1 Lumber: SPF softwood, NLGA No. 2 Grade or better, S4S, kiln-dried with moisture content 19% or less in accordance with CAN/CSA-O141.
- .2 Machine stress-rated lumber is acceptable for all purposes.
- .3 Glued end-jointed (finger-jointed) lumber products certified under NLGA Special Products Standard 1-81 are acceptable except for material for "A" appearance framing to be left unfinished or to be finished with transparent or translucent type coating.
- .4 Furring, blocking, nailing strips, grounds, rough bucks, curbs, fascia backing, and sleepers:
 - .1 S2S is acceptable.
 - .2 Board sizes: "Standard" or better grade.
 - .3 Dimension sizes: "Standard" light framing or better grade.
- .5 Pressure Preservative Treated Lumber: SPF softwood, NLGA No. 2 Grade or better, S4S, kiln-dried with moisture content 19% or less in accordance with CAN/CSA-O141; pressure preservative treated with Copper Azole (CBA-A or CA-B), or Alkaline Copper Quaternary (ACQ) to CSA-O80 Series.

2.2 PANEL MATERIALS

- .1 Construction Sheathing: to CAN/CSA-O325.0, thickness as indicated.
- .2 Canadian Softwood Plywood: to CSA-O151, standard construction, thickness as indicated.
- .3 Pressure Preservative Treated Plywood: Canadian softwood plywood (CSP) to CSA-O151, standard construction; pressure preservative treated with Copper Azole (CBA-A or CA-B), or Alkaline Copper Quaternary (ACQ) to CSA-O80.9 and kiln-dried to a moisture content of 15% or less. Thickness as indicated.
- .4 Fire Retardant Treated Plywood: Douglas Fir Plywood (DFP) to CSA-O121, standard construction; fire retardant treated to CSA-O80.27, kiln-dried to a moisture content of 15% or less, Flame Spread Rating of less than 25 to CAN/ULC-S102. Product must be UL or ULC labeled. Thickness as indicated.

2.3 ACCESSORIES

- .1 Sealants: in accordance with Section 07 92 00.
- .2 General Purpose Adhesive: to CSA-O112 Series.
- .3 Nails, Spikes And Staples: to CSA-B111.
- .4 Proprietary Fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.
- .5 Nailing Discs: flat caps, minimum 25mm diameter, minimum 0.4mm thick, sheet metal or plastic, formed to prevent dishing. Bell or cup shapes not acceptable.
- .6 Finishes
 - .1 Hot-dip galvanized connectors and fasteners to CAN/CSA-G164 minimum 610g/m² coating for:
 - .1 Exterior work (outside of building vapour barrier)
 - .2 Interior highly humid areas
 - .3 Pressure-preservative treated wood, and
 - .4 Fire-retardant treated wood
 - .7 Surface-applied wood preservative: to CAN/CSA-O80 Series; Copper Azole (CBA-A or CA-B) or Alkaline Copper Quaternary (ACQ).

3 EXECUTION

3.1 PREPARATION

- .1 Treat cut surfaces of pressure preservative treated material exposed by cutting, trimming, or boring with wood preservative before installation.
- .2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and one minute soak on plywood.

3.2 INSTALLATION

- .1 Install members true to line, levels and elevations, square and plumb.
- .2 Construct continuous members from pieces of longest practical length.
- .3 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding, electrical equipment mounting boards, and other work as required.
- .4 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .5 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

- .6 Install wood nailers, curbs, and other wood roof supports as required and secure using galvanized steel fasteners.
 - .7 Install sleepers and curbs with top set level as indicated.
 - .8 Install fire retardant plywood backboards for all electrical panel applications, and secure using galvanized steel fasteners, in accordance with sheathing manufacturer's recommendations and fire rating requirements.
 - .9 Install plywood sheathing where scheduled on the drawings.
- 3.3 ERECTION
- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
 - .2 Countersink bolts where necessary to provide clearance for other work.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide glued and cross laminated timber construction, including but not limited to, the following:
 - .1 Design of all connections, wood-to-wood, wood-to-steel and wood-to-concrete, to the requirements of the relevant building code and standards, taking account of the required fire resistance and acoustic performance;
 - .2 Design of alternative equivalent elements;
 - .3 Supply and installation of all connectors and steel plates for wood-to-wood connection assemblies;
 - .4 Supply and installation of all connectors (screws, dowels, bolts) for wood-to-steel and wood-to-concrete connection assemblies;
 - .5 Coordination with related steel and concrete works.
- .2 Steel plates, assemblies and anchors for wood-to-concrete and wood-to-steel connections:
 - .1 All steel plates and assemblies of wood-to-steel connections shall be supplied by the structural steel subcontractor and attached to the steel structure in the steel fabrication workshop;
 - .2 All steel base plates, steel assemblies and concrete anchors for wood-to-concrete connections shall be supplied and installed on site by the structural steel subcontractor.
 - .3 All steel to concrete connections to be supplied and installed by CLT Subcontractor.

- .3 The Work of this Section includes, but is not necessarily limited to, the following:
 - .1 Glued-laminated wood beams and columns;
 - .2 Cross-laminated timber panels;
 - .3 Insulation and Z-Girts,
 - .4 Connection hardware and connectors.

1.3 REFERENCES

- .1 APA PRG 320 – Standard for Performance-Rated Cross-Laminated Timber
- .2 ASTM A123/A123M - Standard specification for zinc (hot-dip galvanized) coatings on iron and steel products
- .3 ASTM A153/A153M - Standard specification for zinc coating (hot-dip) on iron and steel hardware
- .4 ASTM A307 - Standard specification for carbon steel bolts, studs, and threaded rod 60000 psi tensile strength
- .5 ASTM A563 - Standard specification for carbon and alloy steel nuts
- .6 ASTM A 653/A 653M – Standard specification for steel sheet, zinc-coated (galvanized) or zinc-iron alloy-coated (galvannealed) by the hot-dip process.
- .7 CSA-G40.20/G40.21 - General requirements for rolled or welded structural quality steel / structural quality steel
- .8 CSA B111 -Wire nails, spikes and staples
- .9 CAN/CSA, O80 Series, Wood preservation
- .10 CSA O86 - Engineering Design in Wood.
- .11 CSA O112 Series – Evaluation of adhesives for structural wood products
- .12 CSA O122 - Structural glued-laminated timber
- .13 CSA O177 - Qualification code for manufacturers of structural glued-laminated timber
- .14 CAN/CSA-S16 - Design of steel structures
- .15 CSA-S136 – North American specification for the design of cold-formed steel structural members
- .16 CSA W47.1 - Certification of companies for fusion welding of steel
- .17 CSA-W55.3 – Certification of companies for resistance welding of steel and aluminium
- .18 CSA W59 -Welded steel construction (metal arc welding)
- .19 EN 14080 - Timber Structures - Glued-Laminated Timber and Glued Solid Timber -Requirements.
- .20 ASTM A653/A653M; Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .21 CAN/ULC-S702; Standard for Mineral Fibre Thermal Insulation for Buildings.

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

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- .2 Glued-laminated timber elements shall be manufactured in a factory certified by an organization approved by the Standards Council of Canada or equivalent body in the country of origin of the product.
 - .3 After manufacture, submit a certificate in accordance with the requirements of CAN/CSA O177, Appendix B or equivalent.
 - .4 Cross-laminated timber panels shall comply with the requirements of APA PRG 320 or equivalent, certified by a professional engineer registered and licensed in the province of the project or by a recognized certification body. CLT of European origin shall be certified with a European Technical Assessment.
 - .5 When requested, Manufacturer shall confirm application of a sealer or other surface treatment in the factory.
 - .6 The Engineer responsible for the Shop and Erection Drawings shall:
 - .1 Review and report on the manufacturer's and fabricator's quality control tests and reports regarding compliance with the Contract Documents.
 - .2 Conduct inspections of the fabrication and prepare and submit written inspection reports verifying that the products of this section are in accordance with the Contract Documents and reviewed Shop Drawings.
 - .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
 - .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
 - 1.5 SUBMITTALS
 - .1 Shop and Erection Drawings
 - .1 Submit Shop and Erection Drawings in accordance with Section 01 30 00.
 - .2 Submit Shop and Erection Drawings stamped and signed by a qualified professional engineer experienced in design, fabrication and erection of timber structures of comparable complexity and scope and registered and licensed in the province of the project.

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- .3 On each Shop Drawing, indicate member size, material grade, appearance grade, openings, curves and cambers, cutting and drilling required for connections, connection hardware and details and surface finishes.
 - .4 On Erection Drawings, indicate erection procedure and any required installation sequence, relevant details such as member identification, spacing, connections and bearing lengths.
 - .5 Reproduction of the Contract Drawings for use as Shop or Erection Drawings is not permitted.
- .2 Mill Certificates
 - .1 When requested, for steel connection plates, submit mill test reports prior to fabrication of steel elements and accessories. Reports to show:
 - .2 Chemical and physical properties.
 - .3 Other details of steel to be incorporated into work.
 - .4 Certification by qualified metallurgists confirming that tests conform to requirements of CSA G40.20/G40.21.
 - .3 Technical specifications for connectors.
 - .4 Bill(s) of Materials, including columns, beams, connection elements.
 - .5 Manufacturer's data sheets and warranties, including grades and species of wood, adhesives, surface treatments and finishes.
 - .6 Sample material for review and acceptance.
 - .7 Weather protection
 - .1 Indicate methods used for weather protection during erection until building is closed.
 - .2 Indicate methods used for humidity control during erection and until building delivery.
- 1.6 TRANSPORTATION, STORAGE AND HANDLING
- .1 Surfaces of material contaminated with foreign elements shall be factory cleaned prior to transportation or delivery of the products to the project site.
 - .2 Before they leave the factory, wrap the elements, individually or in groups, in a moisture-proof wrapping.
 - .3 Use padded non-marring slings or anchored lifting devices to handle the elements.
 - .4 Protect edges and corners of the elements with wood blocking.
 - .5 Coordinate the schedule of delivery to the project site with the Construction Contractor such that progress of the work is not interrupted.
 - .6 Transport, store and handle equipment, products and materials in accordance with the requirements of their manufacturer.

- .7 Store products to permit easy access for inspection and identification.
- .8 Slit the underside of the wrapping membrane during storage at the site to ensure drainage of condensation, taking care not to damage the elements.
- .9 Store elements on blocks of wood to avoid direct contact with the ground, separated with stripping to allow free air circulation on all sides and protect against wind, rain and snow.

2 PRODUCTS

2.1 MATERIALS

- .1 Lumber: SPF softwood (including Douglas Fir), NLGA No. 2 Grade or better, S4S, kiln-dried with moisture content 19% or less in accordance with CAN/CSA-O141.
- .2 Cross-Laminated Timber Panels: as indicated in the drawings, or equivalent.
- .3 Glue: to meet the requirements of CSA O112, APA PRG 320 or EN 14080, transparent or white, for service class as indicated.
- .4 Sealer:
 - .1 Clear, non-yellowing;
 - .2 Reduces moisture absorption;
 - .3 Protects against UV degradation;
 - .4 Penetrating;
 - .5 Low VOC;
 - .6 Acceptable Product: Sansin KP11 or KP12 WUV
- .5 Fasteners: As specified on the drawings or approved equivalents.
- .6 Bolts: ASTM A307, zinc-plated.
- .7 Steel plates: CAN/CSA G40.21 or ASTM A36, hot-dip galvanized with zinc coating of at least 600 g/m² to CAN/CSA G164.
- .8 Pins and dowels: ASTM A307 or approved equivalent.
- .9 Screws: As specified in the drawings or approved equivalents, coated with zinc at a minimum thickness of 5 µm.
- .10 Z-Girts: designed to accommodate insulation depth and allow full thermal expansion and contraction of sheet; cold-rolled, commercial grade structural quality sheet steel, minimum (16 gauge) 1.519mm base metal thickness; zinc-coated to ASTM A653/A653M, coating designation (G90) Z275.
- .11 Insulation: mineral fibre, processed from rock or slag, to CAN/ULC-S702, Type 1; thicknesses as shown on the drawings;
 - .1 Thermal Resistance: RSI 0.74/25mm.

- .2 Acceptable Products
 - .1 CavityRock™, by Rockwool LLC.
 - .2 CW8 Mineral Fibre Insulation, by Johns-Manville.
 - .3 Thermafiber® RainBarrier 45, by Owens Corning Canada Inc.

2.2 MANUFACTURING

- .1 Stress classes: as specified on drawings.
- .2 Appearance grade of visible surfaces of Cross-laminated timber (CLT): Architectural one side.
 - .1 Mixture of species is not permitted, except where differences are minimal and acceptable;
 - .2 All knot holes and voids measuring over 20 mm are filled with a wood-tone filler or clear wood inserts selected for similarity with the grain and color of the adjacent wood;
 - .3 Unfilled knot holes do not exceed 20 mm when measured in the direction of the lamination length, with the exception that a knot hole may be longer than 20 mm if its area is not greater than 300 mm²;
 - .4 No loose knots;
 - .5 Black knots do not exceed 30 mm in diameter;
 - .6 Excessive knots and clusters of knots are not permitted;
 - .7 Surface finished smooth with no misses or waness permitted;
 - .8 Blue stains and other discolorations not permitted;
 - .9 Resin pockets maximum 5 x 50 mm, no clusters of pockets;
 - .10 Insect damage not permitted;
 - .11 Bark not permitted;
 - .12 Occasional surface shrinkage cracks (checks) permitted;
- .3 Factory-applied sealer: as specified above.
- .4 Mark or number items so that they can be identified during assembly. Marks should not be visible once the assembly is completed.
- .5 Unless otherwise stated, design the steel assembly parts in accordance with CAN/CSA O86 and CAN/CSA S16, so that they resist the axial forces, shear and bending moments.
- .6 Manufacture these parts in accordance with the CAN/CSA S16.
- .7 Galvanize all steel elements, whether intended for interior or exterior locations.
- .8 Fasten Z-bar support girts vertically to substrate using self-drilling, hex-head, stainless steel anchor screws at (12") 305mm o.c. maximum. Z-bar spacing (24") 600mm o.c.
- .9 Install mineral fibre insulation between Z-bars. Cut insulation to fit tightly. Secure insulation with spot daubs of adhesive on back of panels.

2.3 SHOP SEALING

- .1 Clean and prepare surfaces as recommended by the sealer manufacturer.

- .2 Apply sealer under cover, on dry surfaces when surface and air temperatures are above 10 degrees C.
- .3 Maintain dry condition and 10 degrees C minimum temperature until sealer is thoroughly dry.
- .4 After cutting and preparing each element, apply one coat of sealer on end cuts and other cross-cut surfaces.
- .5 Apply one coat of sealer on all surfaces and cuts of each element.

3 EXECUTION

3.1 PREPARATION

- .1 Connection to Existing Work
 - .1 Verify levels, location, dimensions and condition of existing work;
 - .2 Report discrepancies and potential problem areas to Engineer for direction before commencing fabrication.
- .2 Connection to Foundations and Steel Structure
 - .1 Verify levels, location, dimensions, alignment and condition of previous work by others before commencing installation.
 - .2 Report discrepancies and potential problem areas to Engineer and Construction Contractor for direction before commencing installation.
 - .3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIELD QUALITY CONTROL

- .1 The erector shall engage a qualified Professional Engineer experienced in the design, fabrication and erection of timber structures of comparable complexity and scope and registered and licensed in the province of the Place of the Work, who shall conduct inspections of the erection and prepare and submit written inspection reports verifying that the Work of this section is in accordance with the Contract Documents and reviewed Shop Drawings.
- .2 The erector and the Contractor shall record the following items in site logs for perusal by the Consultant and for submission to the Consultant at end of installation:
 - .1 Environmental conditions daily;
 - .2 Deliveries of material to the site, including verified manifests with notes of damaged or missing materials;
 - .3 Installation of each element and verification of each connection for quality control;
 - .4 Equipment used, including drills for screw installation;
 - .5 Modifications to reviewed shop and erection drawings;
 - .6 Photographs of representative elements and connections of each type, as well as documentation of important details.

- .3 The Contractor shall record the following items in a site log for perusal by the Consultant and for submission to the Consultant at Substantial Performance:
 - .1 Environmental conditions at the site daily;
 - .2 Humidity levels in enclosed parts of the building daily;
 - .3 Equipment and methods used to control humidity levels within the enclosed parts of the building daily;

3.3 ERECTION

- .1 Erect timber elements in accordance with final reviewed shop drawings, true and plumb, and with uniform, close-fitting joints. Fit members without trimming, cutting, or other modifications, unless approved in writing by the Consultant.
- .2 Provide temporary shores, guys, braces, and other supports during erection to keep structural glued-laminated timber secure, plumb, and in alignment against wind loads, seismic loads, temporary construction loads, and loads equal in intensity to design loads. Any failure to make proper and adequate provisions for stresses during erection shall be solely the responsibility of the Installer.
- .3 Handle and temporarily support glued-laminated timber to prevent surface damage, crushing, and other effects that might affect the finish.
- .4 Install timber connectors as indicated. Install bolts with same orientation within each connection and in similar connections.
- .5 For screw installation through steel plates, use drill with torque clutch and avoid damage to screws.
- .6 Site cutting or boring of glued-laminated members, other than as shown on shop drawings, is not permitted without written consent of Consultant.
- .7 Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by the Consultant.

3.4 ERECTION TOLERANCES

- .1 Connections used may require tighter tolerances than hereafter specified.
 - .1 Elevation: 3 mm from specified elevation.
 - .2 Plan position: 3 mm from specified plan position.
- .2 For rectangular areas involving more than one panel, the corner-to-corner diagonal measurements shall not differ by more than 0.25% of the length of the shorter side of the rectangle.
- .3 Joints between CLT panels: 5 mm maximum gap.

3.5 PROTECTION

- .1 If timber elements are individually wrapped:

- .1 Do not remove wrappings until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from Work of other trades.
- .2 Coordinate wrapping removal with finishing Work. Retain wrapping where it can serve as a painting shield.
- .3 Slit underside of wrapping to prevent accumulation of moisture inside the wrapping. Do not deface members.
- .4 Within the closed or partially closed building, the Contractor shall control the relative humidity levels to not less than 40%. Direct heaters to avoid direct exposure of wood surfaces to hot dry air currents. Use humidification equipment as required until Substantial Performance.
- .5 Wrapping to be recycled or reclaimed in all possible cases. Disposal to refuse as a last resort.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide all Finish Carpentry work including the following:
 - .1 Supply and installation of all miscellaneous wood & trim.
 - .2 Supply and installation of all wood strapping for Markerboards and Tackboards.
 - .3 Installation of all wood doors.
 - .4 Installation of all hollow metal doors and frames.
 - .5 Installation of all finish hardware.
 - .6 Installation of architectural wood casework and hardware.
- .2 Work of this section includes re-use of salvaged wood for shelving, ceiling finishes, and trim. Work shall include all milling and finishing.

1.3 REFERENCES

- .1 CSA-B111; Wire Nails, Spikes and Staples.
- .2 CAN/CSA-G164; Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CSA-O115; Hardwood and Decorative Plywood.
- .4 CSA-O112 Series; CSA Standards for Wood Adhesives.
- .5 CAN/CSA-O141; Softwood Lumber.
- .6 CSA-O151; Canadian Softwood Plywood.
- .7 CAN/CGSB-11.3; Hardboard.
- .8 ANSI A208.1; Particleboard, Mat-formed Wood.
- .9 ANSI A208.2; Medium Density Fiberboard.
- .10 AWMAC / AWI Quality Standards Illustrated.
- .11 National Lumber Grades Authority (NLGA) Standard Grading Rules for Canadian Lumber.

- .12 National Hardwood Lumber Association (NHLA) Rules for the Measurement and Inspection of Hardwood and Cypress.
- 1.4 SAMPLES
 - .1 Submit samples of each type and profile of all standing and running trim, in accordance with Section 01 30 00. Submit samples of finished Carpentry items in the finishes specified for review by the Consultant. Approved samples shall represent the minimum quality of work for this section.
- 1.5 SHOP DRAWINGS
 - .1 Submit shop drawings in accordance with Section 01 30 00.
 - .2 Indicate details of construction, profiles, jointing, fastening and other related details.
 - .3 Indicate all materials, thicknesses, finishes and hardware.
- 1.6 DELIVERY, STORAGE AND HANDLING
 - .1 Protect materials against dampness during and after delivery.
 - .2 Store materials in ventilated areas, protected from extreme changes of temperature or humidity.
- 2 PRODUCTS**
- 2.1 LUMBER MATERIALS
 - .1 Hardwood Lumber for Finished Work - Exposed to View: AWMAC/AWI QSI - Section 100 Grade II and the following requirements: with straight vertical grain, of quality suitable for transparent finish;
 - .1 Trim, edging and other solid members exposed to view, minimum 19mm thick, sizes as noted on the drawings:
 - .1 Species & Cut: Rift Cut, Anigre (straight grain) Grade A for benches & trim.
 - .2 Softwood Lumber for Concealed Work (interior blocking and furring): AWMAC/AWI QSI - Section 100 Grade 3, of quality suitable for opaque finish;
 - .1 Cabinet Frame and Internal Construction(concealed):
 - .1 Species: Eastern or Northern Pine, Yellow Poplar, Yellow Birch, Basswood or equivalent "whitewood".
 - .3 Salvaged Lumber for Finished Work;
 - .1 Ceiling Planking, Trim, and Edging: sizes as noted on the drawings:
- 2.2 PANEL MATERIALS
 - .1 Shelving: 19mm thickness for spans up to 700, 25mm thickness for longer spans. Poplar or Birch hardwood core veneers, Anigre Plan face veneer for Clear/stained finish; White Birch for painted finish.
 - .2 Canadian Softwood Plywood: to CSA-O151, G2S, standard construction, thickness as indicated.

- .3 Particleboard: interior mat-formed wood, to ANSI-A208.1, Grade M-2, minimum density 700 kg/m³, thickness as indicated.
- .4 Hardboard: to ANSI A135.4, Class 1 (tempered), thickness as indicated.
- .5 Medium Density Fibreboard: to ANSI-A208.2, Grade 130, density 769 kg/m³, thickness as indicated.

2.3 ACCESSORIES

- .1 Nails and staples: to CSA-B111; galvanized to CAN/CSA-G164 for exterior work, interior humid areas and for treated lumber; plain steel finish elsewhere.
- .2 Wood screws: to CSA-B35.4, electroplated steel, type and size to suit application.
- .3 Splines: wood or metal.

2.4 ADHESIVES

- .1 Contact Adhesive: conforming to CAN/CGSB-71.20.
- .2 Hot Melt Adhesive: waterproof type, as approved by the Consultant.
- .3 Sealer: water-resistant sealer or glue.

2.5 FINISHES

- .1 Shop finish work of this section in accordance with AWMAC/AWI QSI Section 1500 and the following; field finish only where shop finish is not practical or desirable.
- .2 Provide Custom Grade Finish as amended by the following:
 - .1 Finish of concealed areas and back priming: apply two coats of sealer to concealed surfaces and backs.
 - .3 Finish System (Interior): Conversion Varnish:
 - .1 Sealer (conversion varnish reduced).
 - .2 Sand (240-320 Grit) to expose 75% of wood grain.
 - .3 Top Coat satin sheen (25-35 Units @60°), high solids content conversion varnish.
- .4 Use wood filler which matches surrounding surfaces and of types recommended for applied finishes.

3 EXECUTION

3.1 INSTALLATION

- .1 Do finish carpentry to AWMAC/AWI Quality Standards Illustrated (QSI), except where specified otherwise.
- .2 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate piping, columns, fixtures, outlets, or

other projecting, intersecting or penetrating objects. Form joints to conceal shrinkage.

- .3 Perform door and frame installation in accordance with National Fire Codes, Volume 4, produced by National Fire Protection Association (NFPA) 80.

3.2 CONSTRUCTION

- .1 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.
- .2 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.
- .3 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round cleanly cut hole and plug with wood plug to match material being secured.
- .4 Replace items of finish carpentry with damage to wood surfaces including hammer and other bruises.
- .5 Panelling: Secure panelling using concealed French Cleat hangers.
- .6 Salvaged Wood ceiling Planks: fasten using concealed fasteners to metal ceiling suspension system provided under Section 09 21 16.

3.3 DOOR INSTALLATION

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00.
- .2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows:
 - .1 Hinge side: 1.0 mm.
 - .2 Latchside and head: 1.5 mm.
 - .3 Finished floor top of carpet and thresholds: 13 mm (6 mm at rated doors).
- .3 Adjust operable parts for correct function.

3.4 FRAME INSTALLATION

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader 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.
- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

- .5 Touch up galvanized finishes damaged during installation with zinc-rich primer.

3.5 INSTALLATION OF FINISH HARDWARE

- .1 Install finish hardware in accordance with manufacturer's supplied templates and installation instructions. Where application of finishing hardware has not been done in a first class manner, replace such work.
- .2 Adjust all hardware for correct function.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide all exterior carpentry work.
- .2 The work of this section also includes the provision of all brackets, connectors, and fasteners necessary to complete the work in a first class manner.

1.3 REFERENCES

- .1 CAN/CSA-O141; Softwood Lumber.
- .2 CSA B111; Wire Nails, Spikes and Staples.
- .3 CAN/CSA G164; Hot Dip Galvanizing of Irregularly Shaped Articles.
- .4 CSA-A23.1-94, Concrete Materials and Methods of Concrete Construction.
- .5 CSA-O80 Series-97; CSA Standards for Wood Preservation.

2 PRODUCTS

2.1 MATERIALS

- .1 Lumber: 16x140mm, T&G, Western Red Cedar, S2S, Tight Knotted Stock (Dressed), moisture content 19% or less in accordance with CAN/CSA 0141.

2.2 ACCESSORIES

- .1 Nails, Screws and Fasteners: to CSA B111, hot dip galvanized to CAN/CSA G164. Use epoxy coated screws for all Pressure Preservative Treated Lumber.

- .2 Strapping: 19x90mm pressure-preservative treated wood strapping as required.

2.3 FINISH

- .1 Stained/Transparent Finish
 - .1 Base Stain: water-based semi-transparent stain; Sikkens Cetol water-based wood stain. Colour – 072 Butternut.
 - .2 Finish Coats: minimum 3 coats clear, UV cured system; "Aqualux II" water-based topcoat finish, by Chromos-Svjetlost.

3 EXECUTION

3.1 CONSTRUCTION

- .1 Install cedar as detailed.
- .2 Mitre corners of wood members exposed to view.
- .3 Coordinate with electrical trade for provision of conduit and boxes for lighting. Conceal conduit wherever possible.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide all mill-fabricated architectural wood casework and associated hardware, including the following:
 - .1 Shop fabrication.
 - .2 Delivery to the site.
 - .3 Installation.

1.3 REFERENCE STANDARDS

- .1 ANSI-A135.4; Hardboard.
- .2 ANSI A208.1; Particleboard, Mat-formed Wood.
- .3 ANSI A208.2; Medium Density Fiberboard.
- .4 ANSI/BHMA-A156.9; Cabinet Hardware.
- .5 AWMAC / AWI Quality Standards Illustrated.
- .6 National Lumber Grades Authority (NLGA) Standard Grading Rules for Canadian Lumber.
- .7 National Hardwood Lumber Association (NHLA) Rules for the Measurement and Inspection of Hardwood and Cypress January.
- .8 CAN3-A172, High Pressure, Paper Base, Decorative Laminates.
- .9 CSA O112.6/O112.7, Resorcinol Resin Adhesive.
- .10 CAN/CGSB-71.19; Adhesive, Contact, Sprayable.
- .11 CAN/CGSB-71.20; Adhesive, Contact, Brushable.
- .12 CSA-B111; Wire Nails, Spikes and Staples.
- .13 CAN/CSA-G164; Hot Dip Galvanizing of Irregularly Shaped Articles.
- .14 CSA-O115; Hardwood and Decorative Plywood.
- .15 CSA-O112 Series; CSA Standards for Wood Adhesives.

- .16 CSA-O121; Douglas Fir Plywood.
- .17 CAN/CSA-O141; Softwood Lumber.
- .18 CSA-O151; Canadian Softwood Plywood.

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 30 00.
- .2 Clearly indicate all materials, details of construction, profiles, jointing, fastening, installation schedule, colours and other related details.
- .3 Details and sections must be minimum 1:10 scale.

1.6 MOCK-UP

- .1 Shop-prepare one typical base cabinet unit of both HDPL and Wood Veneer cabinets, complete with all door and drawer hardware and applied finishes, and install on site at designated location for Consultant's review.
- .2 If approved by the Consultant, the accepted units will establish the base minimum for acceptable work.

- .3 If rejected, remove mock-up unit(s) and replace with unit(s) acceptable to Consultant.
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - .1 Protect finished surfaces against damage with heavy kraft paper over doors and countertops during and after delivery.
 - .2 If required, store millwork in ventilated areas, protected from extreme changes of temperature or humidity.
 - .3 Do not deliver or install millwork until necessitated by coordination with work of other trades, or until area is sufficiently climate controlled so as not to expose millwork to damage from excessive changes in temperature or humidity.
- 1.8 SEQUENCING AND SCHEDULING
 - .1 Do not commence millwork installation until resilient flooring and carpet work has been completed in area to receive millwork.
- 1.9 GUARANTEE
 - .1 The millwork fabricator shall guarantee cabinetwork against warpage, opening of joints, shrinkage, and similar defects for a period of two (2) years from the Date of Substantial Completion.
- 1.10 EXTENDED WARRANTY
 - .1 The millwork fabricator shall supply from the manufacturers of the plastic laminate and the melamine panels standard written warranties against delamination or surface degradation under normal usage for a period of two (2) years from the Date of Substantial Completion.
- 2 PRODUCTS**
 - 2.1 SOURCE QUALITY CONTROL
 - .1 Millwork fabricator will supply to the Consultant, shipping labels and/or bills of lading for panel materials used in the work of this Section, for verification purposes.
 - 2.2 MATERIALS
 - .1 Softwood Lumber for Concealed Work (blocking and furring): AWMAC/AWI QSI - Section 100 Grade 3, of quality suitable for opaque finish;
 - .1 Cabinet Frame and Internal Construction (concealed):
 - .1 Species: Eastern or Northern Pine.
 - .2 Species Yellow poplar, Yellow Birch, Basswood or equivalent "whitewood".
 - .2 Hardwood Lumber for Finished Work - Exposed to View: AWMAC/AWI QSI - Section 100 Grade II and the following requirements: with straight vertical grain, of quality suitable for transparent finish;

- .1 Trim, edging and other solid members exposed to view, sizes as noted on the drawings:
 - .1 Species & Cut: Rift Cut, White Hard Maple Grade A for trim.

- .3 Hardwood Plywood: 3mm veneer on 19mm plywood, to CSA O115 - M graded in accordance with AWMAC/AWI, core materials of veneer, type of glue recommended for application; face veneer and cuts as follows:
 - .1 Poplar or Birch hardwood core veneers.
 - .2 Face veneer and edges:
 - .1 White Hard Maple - Grade AA, Rift cut. Edges 3mm thick solid wood.

- .4 Mat-Formed Wood Particleboard: to ANSI-A208.1, Grade M-2, minimum density 641 kg/m³.

- .5 Hardboard: to ANSI-A135.4, Class 1 (tempered), thickness as indicated.

- .6 Medium Density Fibreboard: to ANSI-A208.2, Grade 130, density 769 kg/m³, thickness as indicated.

- .7 Melamine Composite Panels (MCP)
 - .1 General-purpose grade melamine; resin-impregnated decorative paper thermally fused to core. Minimum 80g paper weight for patterns, 120g for whites and almonds.
 - .1 Core: Medium Density Fiberboard (MDF) to ANSI-A208.2, Grade 130, minimum density 769 kg/m³.
 - .2 Backing Sheet: 0.5mm backing sheet by face sheet manufacturer, same colours as face sheets.
 - .3 Melamine Colour and Gloss: UNIBOARD TFL Panels; Super White 113.
 - .4 Edge Treatment for MCP Panels
 - .1 ABS Edging: Doellken-Woodtape® 3mm thick solid ABS with a measured degree of hardness of 95 Shore D. Edges shall be square & sharp (not eased).
 - .2 Adhesive: Ethylene Vinylacetate Thermalset adhesive with a temperature resistance of not less than 100°C; a processing range of 190 to 200°C. Contact cement or other adhesive not acceptable.
 - .3 Application: Edging material shall be applied using only equipment designed for the application of thick ABS in accordance with the manufacturer's specifications.
 - .4 Colour/pattern: to match panel faces.
 - .5 Bevelled top edges of drawers shall utilize solid core edge banding for colour-through appearance.

- .8 Glass For Doors: 8mm clear tempered safety glass, with smooth ground edges where not concealed by a perimeter frame.

2.3 ADHESIVES

- .1 Contact Adhesive: to CAN/CGSB-71.19 and CAN/CGSB-71.20.
- .2 Hot Melt Adhesive: of approved manufacturer.
- .3 Resorcinol Adhesive: to CSA-O112.6 or O112.7.
- .4 Sealer: water-resistant sealer or glue.

2.4 ACCESSORIES

- .1 Draw Bolts: Industry standard, cadmium plated, self-tightening type for use in panel and countertop jointing.
- .2 Nails and staples: to CSA-B111, plain finish.
- .3 Wood screws: to CSA-B35.4, cadmium plated.
- .4 Sealant: to Section 07 92 00.

2.5 HARDWARE

- .1 All cabinet hardware shall meet or exceed the requirements of ANSI/BHMA-A156.9.
- .2 Manufacturers/Suppliers:
 - .1 CBH - Canadian Builders Hardware Mfg Inc.
 - .2 Ives - HB IVES Hardware
 - .3 Salice - Salice Canada Inc.
 - .4 KV - Knape & Vogt Canada
 - .5 Hafele - Hafele Canada Inc.
 - .6 Blum Canada Limited.
 - .7 Hettich Canada LP.
 - .8 Grass Canada Inc.
 - .9 Richelieu Hardware.
- .3 Finishes:
 - .1 ANO – Anochrome.
 - .2 ANOD - Clear Anodized Aluminum.
 - .3 ZC - Bright Zinc Finish.
 - .4 15 - Satin Nickel
 - .5 32D - Satin Stainless Steel
- .4 Shelf Pilasters-Standards and Clips: Formed steel channels and rests, cut for fitted rests spaced at 25 mm centres; manufactured by KV in ZC finish.
 - .1 Pilaster: KV - 255 x full length (4 pcs per shelf)
 - .2 Clips: KV 256 (4 clips per shelf)
- .5 Hinges: European style, fully concealed, soft-closing, adjustable, zinc-plated steel with satin finish; 105 degree opening; soft closing.

- .1 Product: Salice – SILENTIA Series 900 hinges and series 200 mounting plates. Use equivalent product hinge for any openings requiring greater than 110 degree opening.
- .6 Drawer Slides: zinc-plated steel construction, ball bearing, telescoping track, full extension drawer slides, oil-free soft-closing mechanism, 100 lb. class;
 - .1 Product: KV – 8417, Finish: ANO.
- .7 Drawer and Door Pulls: "D" shaped pull, stainless steel with satin finish, 90mm centres;
 - .1 Product: Richelieu 1093, Finish: 32D.
- .8 Door Pulls (doors over 1200 high): Drawer Pulls: "D" shaped pull, stainless steel with satin finish, 102mm centres;
 - .1 Product: Richelieu 1093, Finish: 32D.
- .9 Locks
 - .1 For Drawers: Schlage CL100, or Olympus 700SC; keyed as directed by Consultant.
 - .2 For Cabinet Doors: Schlage CL100, or Olympus 700SC; keyed as directed by Consultant.
 - .3 Automatic Door Bolt for Double Doors: Hafele 245.58.754.
 - .4 For Tall Cabinets: Hafele Espagnolette 3-point locking system.
- .10 Elbow Catches for pairs of doors with locks: Product: Spring loaded, steel with satin finish;
 - .1 Product: IVES - SP2A92,
- .11 Grommets: 63mm dia. white plastic cable grommet by Hafele Canada Inc.
- .12 Closet Rods and Accessories:
 - .1 Closet Rod: 32 mm Dia. CBH - No. 762 Finish: 32D
 - .2 Rod Flanges: CBH - No. 752
 - .3 Rod Supports: CBH - No. 731- 152 mm high, Finish: C26
 - .4 Closet Shelf Brackets: CBH No. 780 Finish: 32D depth to suit.
- .13 Coat Hooks: Single Hook, formed stainless steel, heavy duty, 50 mm projection, surface mounted with concealed fasteners;
 - .1 Product: CBH-66 Finish: ANOD.
- .14 Levelers (Levelling Foot): 'Hafele' Levelers Product No. 637.05.300: M8 x 45 mm with t-nut and black plastic cap by Hafele Canada Inc.
- .15 Garbage / Recycling Pullout: Euro-Cargo Recycling Centre – 2 bins (38L & 7) with bins and accessories; 361430100, by Richelieu Hardware. Provide "Kick-n-go Foot Pedal" 3695106, by Richelieu Hardware.

- .16 Murphy Bed Hardware: for twin mattress; CIELO horizontal metal frame #8424020 by Richelieu Hardware. CIELO horizontal metal frame with concealed legs #8424120 by Richelieu Hardware.

2.6 FABRICATION

- .1 General
 - .1 Cabinet Components: As specified in AWMAC QSI Section 400-G-8 as amended by the following requirements;
 - .2 Hardware: Supply hinges, drawer slides products and materials as specified.
 - .3 Provide Semi-Exposed surfaces in same quality and finish as Exposed parts.
 - .4 Adjustable Shelf Techniques/Supports: AWMAC QSI Section 400 A-T-11/400 B-T-9;
 - .1 Custom Grade: Adjustable shelf metal shelf standards recessed (mortised) flush only.
- .2 Wood Cabinets Construction: AWMAC QSI Section 400 A, flush overlay style, Custom Grade as amended by the following requirements;
 - .1 Exposed and Semi Exposed Parts (except countertops): Veneer core plywood with Premium face veneer grades as specified.
 - .2 Toe Kicks: Stainless steel.
 - .3 Exposed and Semi Exposed Parts: panel edge band; solid wood same species as face. Lapped joint with top and bottom bands lapping side bands.
 - .4 Wood Veneer Grain Direction: AWMAC QSI Section 400 A-T-1 ;
 - .1 Premium Grade: Grain direction to run vertically for all doors, drawer fronts and overhead bulkheads.
 - .5 Wood Veneer Clad Millwork: Rift cut White (Hard) Maple veneer with Solid Maple edging.
 - .1 Where Maple is requested on the drawings, all cabinet frames whether for base, wall or tall floor standing cases, shall be fabricated so each is a self-contained module. Front side top and bottom, exterior surfaces shall be finished allowing future relocation of any module, into any bench arrangement, without need of any additional finishing.
 - .2 Drawer fronts and counter surfaces shall be fabricated utilizing the same material and edge finish as doors. Fronts will be secured to drawer bodies with five screw nails through the front of the drawer body into the core of the drawer front.
- .3 Hardware: Provide the following special hardware requirements:
 - .1 Cupboard and Cabinet Doors Hinges:
 - .1 Match product quality and manufacturer specified and provide hinge product(s) to suit cupboard and cabinet door thicknesses where they change to suit door heights and dimensions.
 - .2 For doors over 900 mm to 1600 mm high provide three hinges.

- .3 For doors over 1600 mm to 2000 mm high provide four hinges.
- .2 Closet Rod and Shelf Hardware and accessories:
 - .1 Provide two closet shelf brackets per shelf and;
 - .2 Provide shelf brackets @ 900 o.c. typical.
 - .3 Provide a min. of one rod support per closet rod installation.
 - .4 Provide closet rod supports @ 900 o.c. typical.
- .3 Provide millwork locks where indicated on the drawings.
- .4 Counter tops
 - .1 Stainless steel to section 12 35 53.

2.7 FINISHES

- .1 Shop-finish all work of this section in accordance with AWMAC/AWI QSI Section 1500 and the following; no field finishing permitted except for minor re-touching.
- .2 Stain and Varnish Finish;
 - .1 Sealer (conversion varnish reduced).
 - .2 Sand (240-320 Grit) to expose 75% of wood grain.
 - .3 Semi Transparent stain.
 - .4 Top Coat satin sheen (25-35 Units @60°), high solids content conversion varnish.
- .3 Epoxy Top Finish for Dining Table Millwork: two-part food safe epoxy finish; TotalBoat TableTop Epoxy, clear epoxy coating for bars and table tops.

3 EXECUTION

3.1 GENERAL

- .1 Examine the site and take all measurements necessary to ensure accurate and proper fitting of this work into the building and around all obstructions or projections already in place and/or shown on the drawings and to suit the locations of service piping, all as required to produce a neat, first class installation.

3.2 CABINETWORK INSTALLATION

- .1 Install prefinished millwork at locations shown on drawings. Position accurately, level, plumb straight.
- .2 Fasten and anchor millwork securely. Provide heavy-duty fixture attachments for wall-mounted cabinets.
- .3 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects. Provide filler panels of same construction and finish as cabinets. Maximum size of fillers not to

exceed 25mm. Maximum uniform joint between fillers and adjacent wall surface not to exceed 3mm.

- .4 At junction of counter or backsplash and adjacent wall finish, apply small bead of clear sealant in accordance with Section 07 92 00.

3.3 FASTENINGS

- .1 Provide all fastenings, anchors, and accessories required for installation of this work.
- .2 Keep exposed fastenings to a minimum; evenly spaced, and uniformly arranged.
- .3 Supply adequate instructions and/or templates and if necessary supervise installation where fastening or accessories are required to be built into work of other trades.

3.4 HARDWARE INSTALLATION

- .1 Supply and install all finish hardware required for cabinetwork, except for keyed locksets supplied by Section 08 71 00.
- .2 Neatly mortise and fit finishing hardware. Cut mortises straight and sharp without ragged edges and sized accurately to accommodate hardware. Where mortising and application has not been done in a first class manner, such work must be replaced.
- .3 Schedule
 - .1 Hinges: minimum two (2) per door panel, three (3) where doors exceed 1200mm in height.
 - .2 Pulls: One (1) for each door and drawer (finger pulls where indicated).
 - .3 Door and Drawer Bumpers: minimum two (2) per panel.
 - .4 Cabinet Locks: As shown on the drawings. Where locked panel is one of a pair, install interior top and bottom surface bolts to opposite panel.

3.5 PROTECTION

- .1 Cover finished surfaces with heavy kraft paper or put in cartons during shipment. Protect installed laminated surfaces by approved means. Do not remove until immediately before final inspection.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide rigid board insulation.

1.3 RELATED SECTIONS

- .1 Semi-Rigid Mineral Wool Insulation Section 07 21 16
- .2 Foamed Glass Granular Fill Section 31 23 00

1.4 REFERENCES

- .1 CAN/ULC-S102; Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S114; Determination of Non-combustibility of Building Materials.
- .3 CAN/ULC-S701; Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .4 CAN/ULC-S704; Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced.
- .5 CAN/ULC-S770; Standard for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulation Foams.
- .6 CGSB 71-GP-24; Adhesive, Flexible, for Bonding Cellular Polystyrene Insulation.

1.5 SUBMITTALS

- .1 Samples: Submit samples of insulation furring system channels, fasteners and accessories, in accordance with Section 01 30 00.
- .2 Product Data: Submit manufacturer's printed product literature, MSDS sheets, and application instructions for insulation materials in accordance with Section 01 30 00.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to the site in their original unopened packages, bearing all manufacturer's labels.
- .2 Protect packages from damage, and materials from effects of weathering.

2 PRODUCTS

2.1 INSULATION

- .1 Foundation Insulation & General Applications: extruded closed-cell polystyrene foam insulation, to CAN/ULC-S701 Type 4, square edges, manufactured using HCFC-free blowing agents, thickness as shown on the drawings, and as follows;
 - .1 Board size: 600mm x 2400mm.
 - .2 Compressive strength: 210kPa.
 - .3 Flame Spread: less than 50, to CAN/ULC-S102.
 - .4 Vapour Permeance: 90ng/Pa s m² maximum.
 - .5 Long Term Thermal Resistance (LTTR)
 - .1 (R 5.0) RSI 0.87 per 25mm thickness of board.
 - .6 Acceptable Products
 - .1 STYROFOAM™ SM™, by Dow Chemical Canada Inc.
 - .2 CELFORT® 300, by Owens-Corning Canada Inc.

2.2 ADHESIVES

- .1 For polystyrene: to CGSB 71-GP-24M.

3 EXECUTION

3.1 QUALITY OF WORK

- .1 Install insulation after building substrate materials are dry.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .3 Fit insulation tightly around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .4 Keep insulation minimum 75mm from heat emitting devices such as recessed light fixtures.
- .5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .6 Offset both vertical and horizontal joints in multiple layer applications.
- .7 Do not enclose insulation until it has been inspected and approved by Consultant.

3.2 EXAMINATION

- .1 Examine substrates and immediately inform Consultant in writing of defects.
- .2 Prior to commencement of work ensure substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

3.3 INSTALLATION

- .1 General Applications
 - .1 Apply adhesive to substrate by notched trowel in accordance with manufacturer's instructions.
 - .2 Embed insulation boards into adhesive, prior to skinning of adhesive.
 - .3 In addition to adhesive. Install mineral fibre insulation boards with insulation clips, 2 per board minimum, fit boards tight, cut off fastener spindle 3mm beyond disc.
 - .4 Leave unbonded joints in insulation board over line of expansion and control joints.
- .2 Perimeter Foundation Insulation
 - .1 Exterior and Interior application: extend boards vertically from 50mm below finish grade to 1200mm down, installed with adhesive on face of foundation walls.
- .3 Insulation Protection
 - .1 Provide insulation protection at foundation wall until wall assembly is complete. If access to the interior of the building is being gained by equipment and machinery, access points must be covered with a rigid material (plywood) and earth is built up around the opening sufficiently to create a ramp condition. No debris is to enter between the insulation and foundation wall, no gaps or breaks in insulation is acceptable. Any and all damage to foundation insulation over the course of the project is to be repaired to the Consultant's approval before enclosing the building.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide batt and blanket insulation.

1.3 REFERENCES

- .1 CSA-B111; Wire Nails, Spikes and Staples.
- .2 CAN/ULC-S102; Surface Burning Characteristics of Building Materials and Assemblies.
- .3 CAN/ULC-S114; Determination of Non-Combustibility in Building Materials.
- .4 CAN/ULC-S702; Standard for Mineral Fibre Thermal Insulation for Buildings.

2 PRODUCTS

2.1 INSULATION

- .1 Thermal Insulation: mineral fibre, processed from rock or slag, to CAN/ULC-S702, Type 1; thicknesses as shown on the drawings;
 - .1 Thermal Resistance: RSI 0.74/25mm.
 - .2 Acceptable Products
 - .1 CavityRock™, by Rockwool LLC.
 - .2 CW8 Mineral Fibre Insulation, by Johns-Manville.
 - .3 Thermafiber® RainBarrier 45, by Owens Corning Canada Inc.

- .2 Fire Blanket Insulation: mineral fibre processed from rock, slag, or glass, to CAN/ULC-S702 Type 1, non-combustible to CAN/ULC-S114, thickness as shown on the drawings;
 - .1 Fire Hazard Classification: flame spread 25 or less, smoke developed 50 or less, to CAN/ULC-S102.
 - .2 Thermal Resistance: RSI 0.71/25mm.
 - .3 Acceptable Products
 - .1 Unfaced Thermal Fiber Glass Insulation, by Johns-Manville.
 - .2 Flame Spread 25, by Owens Corning Canada Inc.
 - .3 Roxul AFB, by Rockwool LLC.
- .3 Sound Attenuation Insulation: mineral fibre processed from rock, slag, or glass, to CAN/ULC-S702, Type 1, thickness as shown on the drawings;
 - .1 Acoustical Performance:
 - .1 Airborne sound transmission loss: To ASTM E90.
 - .2 Rating sound insulation: To ASTM E413.
 - .3 Sound absorption co-efficients: To ASTM E423.
 - .4 NRC: 0.95 at 50mm thickness.
 - .2 Acceptable Products
 - .1 Sound Attenuation Batt Insulation, by Owens Corning Canada Inc.
 - .2 Roxul AFB, by Rockwool LLC.
 - .3 Sound-SHIELD® Insulation Batts by Johns-Manville.
 - .4 Noise Reducer Sound Attenuation Batt, by CertainTeed Canada .

2.2 ACCESSORIES

- .1 Insulation clips: impale type, perforated 50 x 50mm cold-rolled carbon steel 0.8mm thick, self-adhesive back, spindle of 2.5mm diameter annealed steel, length to suit insulation, 25mm diameter self-locking washers.
- .2 Tape: CCMC approved, Tuck 20502 Contractor's Sheathing Tape, by Canadian Technical Tape Ltd., Montreal PQ.

3 EXECUTION

3.1 INSULATION INSTALLATION

- .1 Install Thermal Insulation to maintain continuity of thermal protection to building elements and spaces.
- .2 Where no means of securing is present, retain insulation in position with insulation clips, installed as recommended by manufacturer. Insulation clips shall be spaced 400mm vertically.
- .3 Fit insulation closely around electrical boxes, pipes, ducts, frames, and other objects in or passing through insulation. Do not compress insulation to fit into spaces.

- .4 Keep insulation minimum 75mm away from heat emitting devices such as recessed light fixtures.
- .5 Do not enclose or build over insulation until it has been inspected and approved by Consultant.
- .6 Install Sound Attenuation insulation in non fire-rated interior wall assemblies, as shown on the drawings.
- .7 Install Ceiling Sound Attenuation insulation in non fire-rated ceiling assemblies, as shown on the drawings. Lay batts loosely over ceiling assembly, butted together.
- .8 Install Fire Blanket/Sound Attenuation insulation in all fire-rated interior wall and ceiling assemblies, where indicated as having fire resistance ratings on the drawings.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide all spray-in-place foam insulation for applications as noted or as scheduled on the drawings.

1.3 REFERENCES

- .1 ASTM E283; Rate of Air Leakage Through Exterior Windows Curtain Walls and Doors.
- .2 CAN/ULC-S102; Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .3 CAN/ULC-S705.1; Thermal insulation - Spray-Applied Rigid Polyurethane Foam, Medium Density, Material Specification.
- .4 CAN/ULC-S705.2; Thermal insulation - Spray-Applied Rigid Polyurethane Foam, Medium Density, Installer's Responsibilities Specification.
- .5 CAN/ULC-S770; Determination of Long Term Thermal Resistance of Closed Cell Thermal Insulating Foams.
- .6 CDPH v1.1-2010; Standard Method For The Testing And Evaluation Of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers.

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents.

Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor(Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.5 DELIVERY, STORAGE AND HANDLING
 - .1 Materials shall be delivered to jobsite in original and clearly marked containers with manufacturer's labels and seals intact.
 - .2 Store solvent base liquids away from excessive heat and open flame, at above freezing temperatures, and free from contact with cold or frozen surfaces.
 - .3 Do not double stack pallets of materials. Provide cover and adequate ventilation.
- 1.6 ENVIRONMENTAL REQUIREMENTS
 - .1 Provide protection and environmental controls in accordance with Section 01 50 00, and CAN/ULC-S705.2.
 - .2 Ventilate areas to receive insulation, in accordance with Section 01 50 00, by introducing fresh air and exhausting air continuously during, and for 24 hours after application to maintain non-toxic, unpolluted, safe working conditions.
 - .3 Provide temporary enclosures to prevent spray and noxious vapours from contaminating air beyond application area.

- .4 Protect workers as recommended by insulation manufacturer. Applicator must wear appropriate breathing apparatus, safety goggles, and other protective clothing and equipment.
- .5 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.
- .6 Apply insulation only when surfaces and ambient temperatures are within manufacturers' prescribed limits.
- .7 Dispose of waste foam daily in location designated by Consultant and decontaminate empty drums in accordance with foam manufacturer's instructions.

2 PRODUCTS

2.1 MATERIALS

- .1 Sprayed Insulation: spray-applied rigid polyurethane foam to CAN/ULC-S705.1, and conforming to CDPH v1.1-2010 (GREENGUARD Children & Schools);
 - .1 Compressive Strength: 222kPa,
 - .2 Density: 30.4 kg/m³ minimum.
 - .3 Flame spread rating: less than 500 to CAN/ULC-S102,
 - .4 Air leakage of less than 0.001 L/s/m² at 75Pa to CAN/ULC-S705.1, per 25mm thickness,
 - .5 Water Vapour Permeance: 86.6 ng/Pa.s.m²
 - .6 Long Term Thermal Resistance (LTTR) of minimum;
 - .1 1.05m² °C/W per 25mm thickness.
 - .7 Acceptable Products;
 - .1 Insulthane Extreme, by Elastochem Specialty Chemicals Inc.
 - .2 Heatlok Soy 200 PLus, by Demilec Inc.
 - .3 WALLTITE ECOv.3, by BASF Canada.
- .2 Primers: in accordance with manufacturers recommendations for surface conditions.

3 EXECUTION

3.1 EXAMINATION

- .1 Verify that all surfaces to receive spray-in-place insulation are clean and free of all frost, oil, rust, or deleterious materials.
- .2 Verify that all environmental conditions required for successful application of materials, can be met.
- .3 Report in writing, any defects in surfaces or conditions which may adversely affect the installation or performance of the products provided under this section.

3.2 PREPARATION

- .1 Mask all adjacent surfaces not to receive spray-in-place insulation which may be damaged or stained by insulation installation.
- .2 Apply primers where recommended by insulation manufacturer.

3.3 APPLICATION

- .1 Apply insulation to clean surfaces in accordance with CAN/ULC-S705.2 and manufacturer's printed instructions.
- .2 Apply insulation in consecutive passes not less than 13mm and not more than 50mm thick, for a total thickness scheduled herein.
- .3 Finished surface of foam insulation shall be free of voids and imbedded foreign objects.
- .4 Avoid overspray of adjacent areas and surfaces.
- .5 Finished installation shall be inspected and approved by Consultant prior to concealment.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide thermal isolation clips for exterior wall panel assemblies.
 - .1 Thermal isolation clips
 - .2 Fasteners
 - .3 Installation
- .2 This Subcontractor shall be responsible to engineer the thermal isolation clips in conjunction with the wall cladding assemblies.

1.3 RELATED SECTIONS

- .1 Thin Veneer Clay Brick Masonry Section 04 21 13.23
- .2 Mass Timber Panels Section 06 12 00
- .3 Metal Siding Section 07 46 19

1.4 REFERENCES

- .1 ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 ASTM A792 - Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .3 ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

- .4 NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.
- .5 NECB SB-10 – Supplementary Standard.
- .6 CAN/ULC-S134-13 - Standard Method of Fire Test of Exterior Wall Assemblies. (Note conducted on both combustible and non-combustible cladding.)

1.5 SUBMITTALS

- .1 Samples
 - .1 Submit samples in accordance with Section 01 30 00.
- .2 Product Data:
 - .1 Manufacturer's data sheets on each product to be used.
 - .2 Preparation instructions and recommendations.
 - .3 Storage and handling requirements and recommendations.
 - .4 Typical installation methods.
- .3 Verification Samples: Two representative units of each type, and size.
- .4 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 30 00.
 - .2 Submit shop drawings detailing construction, assembly, profiles, materials, reinforcement installation for all conditions, sub-framing and accessories, and finishes. All materials, recommendations and details describing the proposed use, design and erection procedures for all anchorage shall be documented and fully described on the shop drawings. Shop drawings to include all necessary shop details and erection diagrams with;
 - .1 member sizes, locations, thickness (exclusive of coatings), metallic coatings and mechanical properties,
 - .2 connection details for attaching to the structure,
 - .3 dimensions, requirements of related work, and critical installation procedures,
 - .4 design loads.
 - .3 Each shop drawing submitted shall bear the stamp and signature of a qualified Professional Engineer registered in the Place of the Work who has coverage of minimum \$1,000,000 liability insurance.
 - .4 Submit copies of engineering calculations and/or certified data verifying the capacity of members, connectors, connections, and the ability of assemblies to meet the design requirements, signed and sealed by the Subcontractor's Engineer.
 - .5 Submit letter of assurance of "professional field review" and "compliance" in accordance with specified Field Quality Control.

1.6 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum five years documented experience.
- .2 Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.
- .3 Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.
- .4 Mock-Up: Construct a mock-up with actual materials in sufficient time for Consultant's review and to not delay construction progress. Locate mock-up as acceptable to Consultant and provide temporary foundations and support.
 - .1 Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
 - .2 If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
 - .3 Retain mock-up during construction as a standard for comparison with completed work.
 - .4 Do not alter or remove mock-up until work is completed or removal is authorized.

1.7 DESIGN AND PERFORMANCE REQUIREMENTS

- .1 Refer to design and performance requirements of individual cladding assemblies specified under those sections.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- .2 Protect from damage due to weather, excessive temperature, and construction operations.

1.9 PROJECT CONDITIONS

- .1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

2 PRODUCTS

2.1 ACCEPTABLE PRODUCTS AND MANUFACTURERS

- .1 ISOCLIP by Iso Clip (distributed by Northern Facades, 6435 Northwest Dr.; Mississauga, ON, Canada L4V 1K2; T: 844-740-2050; E: info@isoclips.com).
- .2 U-kon Wall Brackets with Thermal Isolation, by U-kon Systems North America, Toronto Ontario E: info@u-kon.com.

- .3 EJOT Cross-Fix by EJOT Construction Fastener Systems, Cambridge ON.

2.2 MATERIALS

- .1 Thermal Isolation Clips.
 - .1 Performance and Design Requirements:
 - .1 High Load Capacity per Clip: Less clips may be required compared to synthetic or aluminum clips resulting in less thermal bridging.
 - .2 Built in slotted retaining tab to ease installation of girts.
 - .3 Mounting Orientation: The same regardless of horizontal or vertical girt orientation.
 - .4 Substrates: All, including concrete, concrete block, steel studs or wood.
 - .5 Effective Wall Assembly R-Value: As determined by Architect in combination with Insulation system.
 - .6 Size: based on engineered design for individual wall cladding assemblies.
 - .2 Product: ISO Clip - Thermal Isolation Clip: Assists in creating thermal break between interior and exterior of building. Reduces thermal transfer through building envelope.
 - .1 Standards Compliance:
 - .1 ASHRAE 90.1, NECB SB-10 compliance, with thermal analysis available.
 - .2 NFPA 285: Pass.
 - .3 CAN / ULC S134: Pass.
 - .2 Clip Material: 14ga ASTM A792 Galvalume or ASTM A653 Galvanized, steel.
 - .3 Thermal Isolator Pad: Glass fibre reinforced polyamide.

3 EXECUTION

3.1 EXAMINATION

- .1 Do not begin installation until substrates have been properly constructed and prepared.
- .2 If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- .1 Clean surfaces thoroughly prior to installation.
- .2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- .1 Install cladding support system components in accordance with manufacturer's written instructions, approved submittals, and the following:
 - .1 Install in proper relationship with adjacent materials.

- .2 Install cladding support system assembly level, plumb, and square within 1/8 inch in 20 ft. (3.2 mm in 6.1 m) noncumulative allowable tolerance.
- .2 Install cladding support system in compliance with orientation, sizes, and locations as indicated.
 - .1 Use termination trim at rough openings to properly transition and enclose continuous insulation (CI) system to provide thermally broken transition from opaque wall assemblies.
 - .2 Trim to be covered by exterior cladding materials and flashings.
- 3.4 FIELD QUALITY CONTROL
 - .1 Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.
 - .2 Manufacturer's Services: Coordinate manufacturer's services in accordance with appropriate sections in Division 01.
- 3.5 CLEANING AND PROTECTION
 - .1 Clean products in accordance with the manufacturer's recommendations.
 - .2 Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide sheet vapour retarders for the following applications:
 - .1 Under Concrete Slab-on-grade

1.3 RELATED SECTIONS

- .1 Air Barriers Section 07 27 00

1.4 REFERENCES

- .1 CAN/CGSB-51.34-M86; Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.

1.5 JOB MOCK-UP

- .1 Construct mock-up of sheet vapour retarder installation including one lap joint, one inside corner and at one electrical box.
- .2 Notify Consultant when mock-up is complete and allow sufficient time for inspection before proceeding with this work.
- .3 If accepted without revision, mock-up will demonstrate minimum standard for this work, and may form part of the finished Work. If rejected, mock-up must be removed, re-built, and re-inspected until approved.

2 PRODUCTS

2.1 SHEET VAPOUR RETARDER

- .1 Underslab Application: Polyethylene film (15 mils) 0.375mm thick;
 - .1 PERMINATOR™ by W.R. Meadows of Canada.
 - .2 Stego Wrap Vapor Barrier, by Stego Industries LLC, as distributed by DRE Industries Inc.

2.2 ACCESSORIES

- .1 Joint sealing tape
 - .1 For Underslab Applications: 100mm wide for lap joints and perimeter seals;
 - .1 PERMINATOR™ TAPE by W.R. Meadows of Canada.
 - .2 Stego Tape by Stego Industries LLC, as distributed by DRE Industries Inc.
- .2 Sealant: butyl rubber acoustical sealant in accordance with Section 07 92 00.
- .3 Staples: steel, with minimum 6mm leg.

3 EXECUTION

3.1 EXAMINATION

- .1 Ensure mechanical and electrical services to be concealed within building envelope, are installed and inspected prior to installation of vapour retarder.
- .2 Ensure base course for concrete slab-on-grade is placed and compacted.

3.2 INSTALLATION

- .1 Underslab Application
 - .1 Install polyethylene sheet vapour retarder over compacted base prior to installation of concrete to form continuous barrier.
 - .2 Cut sheet vapour retarder to form around openings and irregular objects and ensure material is lapped and sealed.
 - .3 Unroll vapour barrier with the longest dimension parallel with the direction of the concrete placement.
 - .4 Lap vapour barrier over footings and/or seal to foundation walls.
 - .5 Overlap joints 150mm and continuously seal with manufacturer's tape.

- .6 Seal all penetrations (including pipes) per manufacturer's instructions.
- .7 No penetration of the vapour barrier is allowed except for reinforcing steel and permanent utilities.
- .8 Repair damaged areas by cutting patches of vapour barrier, overlapping damaged area 152mm and taping all sides with tape.
- .2 Surface Openings
 - .1 Cut sheet vapour retarder to form around openings and irregular objects and ensure material is lapped and sealed.
- .3 Perimeter Seals
 - .1 Seal perimeter of sheet vapour retarder as follows:
 - .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
 - .2 Lap sheet over sealant and press into sealant bead.
 - .3 Install staples through lapped sheets at sealant bead into wood substrate.
 - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.
- .4 Lap Joint Seals
 - .1 Seal lap joints of sheet vapour retarder as follows:
 - .1 Attach first sheet to substrate.
 - .2 Apply continuous bead of sealant over solid backing at joint.
 - .3 Lap adjoining sheet minimum 150mm and press into sealant bead.
 - .4 Install staples through lapped sheets at sealant bead into wood substrate.
 - .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.
- .5 Electrical Boxes
 - .1 Seal electrical switch and outlet device boxes that penetrate vapour retarder as follows:
 - .1 Install molded vapour barrier boxes. Wrap boxes with film sheet providing minimum 300mm perimeter lap flange.
 - .2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide complete air barrier membrane, including the following:
 - .1 Preparation of substrates for installation of membrane,
 - .2 Installation of membrane, and
 - .3 Installation of all periphery detailing around all interruptions in, penetrations through, and terminations of membrane.

1.3 RELATED SECTIONS

- .1 Vapour Retarders Section 07 26 00

1.4 REFERENCE STANDARDS

- .1 ASTM C920; Standard Specification for Elastomeric Joint Sealants.
- .2 ASTM D412; Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
- .3 ASTM D882; Test Methods for Tensile Properties of Thin Plastic Sheeting.
- .4 ASTM E96; Test Methods for Water Vapor Transmission of Materials.
- .5 ASTM E283; Test Method for Determining the Rate of Air Leakage Through Exterior Windows Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen.
- .6 ASTM E1677; Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls.

1.5 QUALITY ASSURANCE

-
- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
 - .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.6 DELIVERY, STORAGE AND HANDLING
- .1 Deliver all products to the site in manufacturer's original unopened packages with all labels intact.
 - .2 Store materials in such a manner so as to protect them from precipitation, ground moisture, and temperature extremes. Raised platforms, waterproof coverings or interior storage shall be employed when and where necessary.
- 1.7 ENVIRONMENTAL REQUIREMENTS
- .1 Do not install solvent curing sealants or vapour release adhesive materials in enclosed spaces without ventilation.
 - .2 Maintain temperature and humidity recommended by materials manufacturers before, during and after installation.
 - .3 Concrete block substrates shall be cured for a minimum of seven (7) days prior to application of air/vapour barrier products. Concrete substrates shall be cured for a minimum of fourteen (14) days prior to application of

air/vapour barrier products. All substrates shall be allowed to dry a minimum of 24 hours following any precipitation.

1.8 COORDINATION

- .1 Coordinate work of this Section with all related Sections.
- .2 Sequence work to permit installation of materials in conjunction with related air/vapour seals.
- .3 Schedule work such that insulation or building veneer installation follows as closely as possible the installation of the air barrier system so as to minimize exposure.

1.9 EXTENDED WARRANTY

- .1 Provide a three (3) year extended system warranty against defects in manufacturer's materials or defective installation. Warranty shall include coverage of installed materials which fail to achieve air tight and watertight seal, exhibit loss of adhesion/cohesion, or do not cure.

2 PRODUCTS

2.1 STEEL STUD CONSTRUCTION

- .1 Self-Adhesive Sheet Air/Vapour Barrier Membrane: composite sheet of rubberized asphalt integrally bonded to high density polyethylene film;
 - .1 Thickness: 1.0mm.
 - .2 Air leakage: less than 0.005 L/s.m² @75Pa to ASTM E283,
 - .3 Water vapour permeance: 1.6 ng/Pa.m².s to ASTM E96,
 - .4 Low temperature flexibility: -30°C to CGSB 37-GP-56M.
 - .5 Elongation: 200% to ASTM D412-modified.
 - .6 Acceptable Products;
 - .1 Blueskin SA, by Bakor Inc.
 - .2 Air Shield, by W.R. Meadows of Canada.
 - .3 ExoAir™ 110, by Tremco Limited.
 - .4 Sopraseal Stick 1100, by Soprema.
 - .5 CCW-705, by Carlisle Coatings and Waterproofing.
- .2 Transition Membrane: same material as main membrane except in 305mm, 450mm, and/or 914mm wide rolls as required.
- .3 Through-wall Flashing Membrane and Dampproof Course (Self-Adhering): SBS-modified bitumen, self-adhering sheet membrane with cross-laminated polyethylene film:
 - .1 Thickness: 1.0mm.
 - .2 Air leakage: less than 0.005 L/s.m² @75Pa to ASTM E283,
 - .3 Water vapour permeance: 1.6 ng/Pa.m².s to ASTM E96,
 - .4 High Temperature Stability: 110°C minimum, to ASTM D5147 (resistance to flow),
 - .5 Low temperature flexibility: -30°C to CGSB 37-GP-56M.
 - .6 Acceptable Products;
 - .1 Bakor Blueskin® TWF, by Henry Company Canada Inc.

- .2 Rub-R-Wall Transition Strip by Advanced Coatings Inc.
- .3 ExoAir™ 110, by Tremco Limited.

- .4 Through-wall Flashing and Dampproof Course Mastic: synthetic rubber-based compound:
 - .1 Compatible with air/vapour barrier membrane, substrate and insulation materials,
 - .2 Long term flexibility: Pass CGSB 71-GP-24M,
 - .3 Chemical resistance: Alkalis, mild acid and salt solutions.
 - .4 Acceptable Products;
 - .1 Bakor Air Bloc 21 or 230-21 Adhesive, by Henry Company Canada Inc.

- .5 Primer
 - .1 Synthetic rubber-based, adhesive type, quick setting;
 - .1 Weight: 0.8 kg/l,
 - .2 Solids by weight: 35%,
 - .3 Drying time (initial set): 30 minutes.
 - .4 Acceptable Products;
 - .1 Bakor Blueskin Primer, by Henry Company Canada Inc.

- .6 Termination Sealant: polymer-modified sealing compound:
 - .1 Compatible with sheet waterproofing membrane and substrate.
 - .2 Solids by volume: 70%
 - .3 Vapour permeance: 2.9 ng/Pa.m².s, ASTM E96,
 - .4 Complies with CGSB 37.29,
 - .5 Remains flexible with ageing,
 - .6 Adheres to wet surfaces,
 - .7 Chemical resistance: Alkalis, calcium chloride, mild acid and salt solutions.
 - .8 Acceptable Products
 - .1 Bakor POLYBITUME® 570-05, by Henry Company Canada Inc.
 - .2 Rub-R-Wall Airtight Mastic, by Advanced Coatings Inc.

- .7 Construction Joint Sealant: moisture cure, medium modulus polymer modified sealing compound:
 - .1 Compatible with sheet air barrier, roofing and waterproofing membranes and substrate,
 - .2 Complies with ASTM C 920, Type S, Grade NS, Class 25,
 - .3 Elongation: 450 – 550%,
 - .4 Remains flexible with aging,
 - .5 Seals construction joints up to 1 inch wide.
 - .6 Acceptable Products
 - .1 Bakor HE925 BES Sealant, by Henry Company Canada Inc.

2.2 CLT PANEL CONSTRUCTION

- .1 Self-Adhered Vapour Permeable Air Barrier

- .1 Vaproshield WrapShield SA Self-Adhered air barrier. Water vapour transmission to ASTM E96/E96M: 40.45 US Perm (2314 ng/s-sm-Pa).
- .2 Rothoblaas Clima Control 80 membrane with variable vapour diffusion. Dry/wet cup water vapour transmission to ASTM E96/E96M: 1.86/10.6 US Perm (106/605 ng/s-sm-Pa).
- .3 Dorken Delta-Vent SA Self Adhered Water Resistive Barrier and Air Barrier. Water vapour transmission to ASTM E96-05: Procedure A: 214 g/s-sm-24h).
- .4 3M 3015VP Vapour Permeable Air Barrier. Water vapour transmission to ASTM E96-05: Desiccant Method: 685 ng/Pa./s.m. (12 perms), Water Method: 970 ng/Pa./s.m. (17 perms).

3 EXECUTION

3.1 GENERAL

- .1 Examine all substrates to receive air barrier system, to ensure they are suitable for installation to commence. Report any unsatisfactory conditions in writing to the Design-Builder prior to commencement of the installation.
- .2 Surfaces shall be clean, dry, continuous and be free of voids, excessive gaps and foreign matter that would impair the adhesion or regularity of the air barrier installation.
- .3 Tape joints in sheathing boards, and fill cracks in masonry or concrete with mastic.
- .4 Have Consultant inspect air barrier installation immediately upon completion. Deficiencies must be corrected immediately. Replace any torn sheet membranes, and touch up any liquid-applied membranes.

3.2 PREPARATION

- .1 Clean and prime substrate surfaces to receive air barrier in accordance with manufacturer's instructions.

3.3 SELF-ADHESIVE SHEET AIR BARRIER MEMBRANE INSTALLATION

- .1 Primer for Transition and Through-wall Flashing Membrane (Self-Adhering)
 - .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 self-adhering transition membrane or self-adhering through-wall flashing membrane during the same working day must be re-primed.
- .2 Transition Membrane (Self-Adhering)

- .1 Align and position transition membrane, remove protective film and press firmly into place. Ensure minimum 50mm overlap at all end and side laps.
 - .2 Tie-in to window frames, aluminium 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 primary liquid air vapour barrier membrane.
- .3 Through-wall Flashing Membrane & Dampproof Course (Self-Adhering)
- .1 Apply through-wall flashing and dampproof coursing membrane in accordance with CSA A371-94 Masonry Construction for Buildings; along the base of masonry veneer walls, over windows, doors and other wall openings required to be protected.
 - .2 Applications shall form a continuous flashing membrane and shall extend up a minimum of 200 mm up the back-up wall.
 - .3 At the end of each days work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic. Trowel apply a feathered edge to seal termination and shed water.
 - .4 Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. At locations where flashing terminates or intersects wall openings including door frames, “end dam” flashing to protect openings and redirect water out. Trim off excess as directed by the consultant.
 - .5 Apply dampproof coursing membrane over slabs on grade, prepare and prime surfaces, align and position membrane between slab and masonry block work.
 - .6 Align and position the leading edge of self-adhering through-wall flashing membrane with the front horizontal edge of the foundation walls, self angles and other substrates to be protected, partially remove protective film and roll membrane over surface and up vertically.
 - .7 Press firmly into place. Ensure minimum 50mm overlap at all end and side laps. Promptly roll all laps and membrane to affect the seal.
 - .8 Ensure all preparatory work is complete prior to applying self-adhering through-wall flashing membrane.

- .9 Ensure through-wall flashing membrane extends to within 6mm of the exterior face of the exterior masonry veneer. Trim off excess as directed by the Consultant.
- .4 Air/Vapour Barrier Membrane
 - .1 Apply self-adhering membrane complete and continuous to prepared and primed substrate in an overlapping shingle fashion and in accordance with manufacturer's recommendations and written instructions. Stagger all vertical joints.
 - .2 Align and position self-adhering membrane, remove protective film and press firmly into place. Ensure minimum 50mm overlap at all end and side laps. Promptly roll all laps and membrane with a counter top roller to affect the seal.
 - .3 At the end of each days work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic. Trowel apply a feathered edge to seal termination and shed water.
 - .4 Tie-in to window frames, aluminium screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings. Refer to manufacturers' standard details.
 - .5 Ensure all projections, including wall ties, are properly sealed with a caulk application of liquid air seal mastic.
 - .6 Mechanically fasten membrane through securement bars to all window, door, louvers and curtain wall sections as recommended by membrane manufacturer where proper adhesion and bonding cannot be maintained.
 - .7 Membrane applied to the underside of substrate surfaces shall receive special attention on application to ensure maximum surface area adhesion is obtained.
- .5 Inspection
 - .1 Notify Consultant when sections of work are complete so as to allow for review prior to installing insulation.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide the prefabricated aluminum wall panels. Panel system requirements include the following components:
 - .1 Aluminum faced aluminum panels with mounting system. Panel mounting system including anchorages, shims, furring, fasteners, gaskets and sealants, related flashing adapters, and masking (as required) for a complete watertight installation.
 - .2 Parapet coping, fascia, soffits, items indicated as integral components of the panel system or as designed.

1.3 REFERENCES

- .1 American Architectural Manufacturers Association
- .2 AAMA 508: Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems
- .3 ASTM E330; Structural Performance of Exterior Windows, Curtain Walls, and Doors Under the Influence of Wind Loads
- .4 ASTM E283; Rate of Leakage through Exterior Windows, Curtain Walls, and Doors
- .5 ASTM D1781; Climbing Drum Peel Test for Adhesives
- .6 ASTM E84; Surface Burning Characteristics of Building Materials
- .7 ASTM D3363; Method for Film Hardness by Pencil Test

- .8 ASTM D2794; Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- .9 ASTM D3359; Methods for Measuring Adhesion by Tape Test
- .10 ASTM D2247; Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
- .11 ASTM B117; Method of Salt Spray (Fog) Testing
- .12 ASTM D822; Practice for Operating Light and Water Exposure Apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products
- .13 ASTM D1308; Effect of Household Chemicals on Clear and Pigmented Organic Finishes
- .14 ASTM D1735; Method for Water Fog Testing of Organic Coatings.
- .15 ASTM D1929; Standard Test Method for Determining Ignition Temperature of Plastics
- .16 ASTM D635; Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- .17 ASTM E119; Standard Test Methods for Fire Tests of Building Construction and Materials
- .18 ASTM E162; Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
- .19 CAN/ULC S114; Standard Method of Test for Determination of Non-Combustibility in Building Materials.

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)

- .3 Product Manufacturer and/or Distributor (Technical Representatives)
- .4 Related Subcontractors whose work is affected by that of this Section.

1.5 MOCKUP

- .1 Construct a full-size mockup on site directed by the consultant. The Consultant will determine exact number of panels and appropriate location.
- .2 Mockup could be waived in lieu of representative corner sample illustrating exact system, material and attachment method.
- .3 Approved representative mockup sample panel shall serve as quality of standard and workmanship to be expected during field quality control inspections of the work being executed and at completion.

1.6 DESIGN CRITERIA

- .1 The design, fabrication and erection of a complete aluminum building panel system is the responsibility of this subcontractor and is based on the performance criteria specified. The system shall be a dry joint system which shall incorporate a pressure equalized "rainscreen" system on a complete air and vapour seal, not only allowing air and vapour which enters the panel chamber to drain to the exterior of the wall, but will also allow air into the pressuring chamber to provide instantaneous pressure equalization. Vents and drain holes shall be inconspicuously located and in such positions as not to contribute to staining, streaking or marking of the panel face. Emphasis shall be placed upon the prime integrity of the critical inner air/vapour seal.
- .2 Design and install specified Aluminum building panel system and all connections to withstand earthquake forces in accordance with the requirements of Ontario Building Code.
- .3 The specified Aluminum building panel assembly shall be designed to accommodate the structural inter-storey drifts and other movements without breakage, dislodgment or connection failure.
- .4 Wind and suction loads normal to the plane of the assembly shall be calculated in accordance with the [Governing Building Code.]
- .5 The Aluminum panel system shall be designed to withstand local positive and negative wind load pressures at a maximum deflection of L/60 measured at the centers of panels, and L/180 measured at perimeters.
- .6 Provide for free noiseless thermal movement of components as may be caused by a temperature variation.
- .7 Allow for movement in cladding caused by deflection in structure.
- .8 Design wall system to allow for the unobstructed movement of air between the exterior and interior sides of metal cladding in Accordance with industry accepted Rain Screen Principles.

- .9 Ensure panel exhibits no permanent deformation when subject to design criteria specified.
 - .10 The system shall provide clear internal paths of drainage in order to drain any trapped moisture to the exterior, discharging moisture in a manner avoiding staining of architectural finishes, collecting in puddles, formation of unsafe icicles and dripping onto pedestrians.
 - .11 Fasten panel assembly to building structure in a manner which transmits all loads to the main structure without exceeding the capacity of any fastener.
 - .12 Individual panels shall be removable without disturbing adjacent panels.
 - .13 Panels shall not warp or buckle when under full design loads.
 - .14 All fastenings and connectors shall be concealed. Connection and attachment devices shall not cause staining to cladding or other adjoining materials. The anchorage system shall be designed so that the panels are secured yet "free-floating", to accommodate expansion and contraction.
 - .15 The system shall not incorporate sealant between panel joints. A Joint Reveal Filler Strip of same material and colour as panels to be incorporated.
 - .16 Anchor assemblies or connection hardware, including all related connections, tracks, girts, fasteners, etc., for and related to the cladding panels shall be designed, engineered, furnished and installed as required in compliance with the specified design and performance criteria. All such items are schematic and do not necessarily indicate the exact required scope, type, shape or profile. Location and methods of anchoring panels shall be the subcontractor's responsibility, who shall design the cladding panels and connections to suit each specific condition in an acceptable manner complying with requirements specified.
 - .17 Panel system shall be in compliance with the Ontario Building Code, and local authorities having jurisdiction.
- 1.7 SUBMITTALS
- .1 Submittals shall be in conformance with Section 01 30 00.
 - .2 Submit shop drawings detailing construction, assembly, profiles, materials, reinforcement installation for all conditions, method of sealing and flashing, sub-framing and accessories, colours and finishes. All materials, recommendations and details describing the proposed use, design and erection procedures for all anchorage shall be documented and fully described on the shop drawings.

- .3 Engineered shop drawings shall be prepared, signed and sealed by a professional structural engineer, attesting to the ability of the Aluminum building system to withstand specified loads.
 - .4 Submit letter of assurance of “professional field review” and “compliance” in accordance with specified Field Quality Control.
 - .5 Submit 600 mm (24 in) x 600 mm (24 in) finished sample panel representative of panel, attachments, reinforcement, construction and finish to the Consultant for approval.
 - .6 Submit two (2) 300 mm (12 in) x 300 mm (12 in) samples of each finish selected by the Consultant.
 - .7 Submit copies of aluminum building panel fabricator’s current “System” “Testing” (by a third party independent testing agency) to ASTM E283-84 for air infiltration 6.24 PSF = 1.30 in. H₂O to have a maximum allowable flow rate of 0.06 CFM/sq.ft. , ASTM E331-86 for water infiltration no uncontrolled water penetration at 12 psf for a 15 minute test duration, and ASTM E330 structural performance allowable deflection of 0.53” at 40psf, for proposed system, prior to bid closing.
 - .8 Submit manufacturer’s documentation covering care, cleaning and maintenance of panels for incorporation into the Owner’s operating and maintenance manuals.
- 1.8 DELIVERY, STORAGE AND HANDLING
- .1 Protect finish and edges in accordance with panel manufacturer's recommendations.
 - .2 Store material in accordance with panel manufacturer's recommendations.
- 1.9 WARRANTY
- .1 Panels: Against oil canning or buckling due to thermal movement or building structure deflections.
 - .2 Kynar (Duranar) Panel Finish: Against non-uniform fading during warranty period to extent that adjacent panels have a gloss and/or colour range greater than originally-accepted samples approved by the Consultant, pitting or other type of corrosion resulting from natural elements in local atmosphere, discoloration, staining or streaking of panel surface. Spray applied Finish Warranty shall be for a period of Ten (10) years from date of Substantial Completion

- .3 Sealant: Against adhesive or cohesive failure of joints between dissimilar material, fluid, migration, dirt pickup, dirt runoff, chalking or visible colour change on surface or cured sealant.
- .4 Material and workmanship warranty against defects or deficiencies shall be for a period of One (1) year and now date of substantial completion.

2 PRODUCTS

2.1 ACCEPTABLE PRODUCTS AND MANUFACTURERS

- .1 Alucobond Easy-Fix, by Sobotec, 67 Burford Rd., Hamilton, ON
- .2 Alumtech aluminum composite panels, 75 Midwest Rd., Scarborough, ON
- .3 Alpolc aluminum composite panels by Nortem, Pennsylvania Ave., Woodbridge, ON

2.2 ALUMINUM BUILDING PANELS

- .1 Panel Thickness: 4mm.
- .2 Panel Weight:
 - .1 4mm panel: 7.76 kg/m².
- .3 Composition:
 - .1 Two sheets of aluminum sandwiching a solid core of fire retardant material formed in a continuous process with no glues or adhesives between dissimilar materials. Core material shall be free of voids and/or air spaces and not contain foamed insulation material.
- .4 Aluminum Face Sheets:
 - .1 Alloy: AA3000 Series (Painted material) AA5000 Series (Anodized material)
- .5 Tolerances
 - .1 Panel Bow: Maximum 1.0% of any panel dimension.
 - .2 Panel Dimensions: Field fabrication shall be allowed where necessary, but shall be kept to an absolute minimum. All fabrication shall be done under controlled shop conditions when possible.
 - .3 Panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle.
 - .4 Maximum deviation from panel flatness shall be 3mm in 1525mm on panel in any direction for assembled units. (Non-accumulative - No Oil Canning)
- .6 System Characteristics

- .1 System must not generally have any visible fasteners, telegraphing or fastening on the panel faces or any other compromise of a neat and flat appearance.
 - .2 Fabricate panel system to dimension, size, and profile indicated on the drawings based on a design temperature of 21°C.
 - .3 Fabricate panel system so that no restraints can be placed on the panel, which might result in compressive skin stresses. The installation detailing shall be such that the panels remain flat regardless of temperature change and at all times remain air and water tight.
 - .4 The finish side of the panel shall have a removable plastic film applied prior to fabrication, which shall remain on the panel during fabrication, shipping, and erection to protect the surface from damage.
 - .7 System Type
 - .1 Rout and Return – Dry Joint
 - .1 System must provide a perimeter aluminum extrusion with integral weather-stripping as detailed on drawings.
 - .2 No field sealant required in joints unless specifically noted on drawings.
- 2.3 PRODUCT PERFORMANCE
- .1 Panels shall be capable of withstanding building movements and weather exposures based on the following test standards.
 - .2 Bond Integrity: When tested for bond integrity, in accordance with ASTM D1781 (simulating resistance to panel delamination), there shall be no adhesive failure of the bond a) between the core and the skin nor b) cohesive failure of the core itself below the following values:
 - .1 Peel Strength: 115 Nmm/mm as manufactured; 15 Nmm/mm after 21 days soaking in water at 21°C.
 - .3 Fire Performance
 - .1 ASTM E84: Flame Spread Index - 00, Smoke Developed Index - 10.
 - .2 ASTM D1929: A self ignition temperature of 447°C or greater
 - .3 ASTM E119: pass.
 - .4 ASTM E162: pass.
 - .5 CAN/ULC S134: pass.
 - .6 Panels shall conform to the requirements of CAN/ULC-S114 for non-combustibility in building materials.

- .4 Wind Load
 - .1 Panels shall be designed to withstand the Design Wind Load based upon the local building code, but in no case less than 97.6 kg/m² and 146.4 kg/m² on parapet and corner panels. Wind load testing shall be conducted in accordance with ASTM E330 to obtain the following results.
 - .2 Normal to the plane of the wall between supports, deflection of the secured perimeter-framing members shall not exceed L/175 or 19mm, whichever is less.
 - .3 Normal to the plane of the wall, the maximum panel deflection shall not exceed L/60 of the full span.
 - .4 Maximum anchor deflection shall not exceed 1.5mm.
 - .5 At 1-1/2 times design pressure, permanent deflections of framing members shall not exceed L/100 of span length and components shall not experience failure or gross permanent distortion. At connection points of framing members to anchors, permanent set shall not exceed 1.5mm.
- .5 Air/Water System Test
 - .1 Air Infiltration - When tested in accordance with ASTM E283, air infiltration at 0.075kPa must not exceed 0.028L/s/m² of wall area.
 - .2 Water Infiltration - Water infiltration is defined as uncontrolled water leakage through the exterior face of the assembly. Systems not using a construction sealant at the panel joints (i.e. Rout and Return Dry and Rear Ventilated Systems) shall be designed to drain any water leakage occurring at the joints. No water infiltration shall occur in any system under a differential static pressure of 0.298kPa after 15 minutes of exposure in accordance with ASTM E331.

2.4 ACCESSORIES

- .1 Extrusions, formed members, sheet, and plate shall conform with ASTM B209 and the recommendations of the manufacturer.
- .2 Panel stiffeners, if required, shall be structurally fastened or restrained at the ends and shall be secured to the rear face of the aluminum panel with silicone of sufficient size and strength to maintain panel flatness. Stiffener material and/or finish shall be compatible with the silicone.
- .3 Sealants and gaskets within the panel system shall be as per manufacturer's standards to meet performance requirements.

- .4 Fabricate flashing materials from 0.762mm minimum thickness aluminum sheet painted to match the adjacent curtain wall / panel system where exposed. Provide a lap strap under the flashing at abutted conditions and seal lapped surfaces with a full bed of non-hardening sealant.
- .5 Fasteners (concealed/exposed/non-corrosive): Fasteners as recommended by panel manufacturer. Do not expose fasteners except where unavoidable and then match finish of adjoining metal.
- .6 Reveal Joint Filler: to be same material and colour as panels.
- .7 Panel joints: Extruded aluminum full-length perimeter frame as detailed on drawings.

2.5 SUPPORT MEMBERS, FASTENERS, CONNECTORS

- .1 Type, size quantity and spacing of all connectors, supporting track, girts, fasteners and other hardware and anchorage devices for panels as required to suit specified standards.
- .2 Panel Clips: preformed cladding support clip as supplied by panel supplier.
- .3 Fastening devices between aluminum or aluminum and other materials shall be aluminum or stainless steel that will not permit staining.
- .4 Self-locking fasteners shall be stainless steel with nylon inserts or patches.
- .5 Use Non-Metal shims as required for panel alignment.
- .6 Subgirts: Minimum 1.2mm (.050 in) Z275 galvanized steel as per manufacturer's requirements for panel attachment system.

2.6 FLASHING AND TRIM

- .1 Provide custom factory-fabricated integral companion flashing, trims, end caps and finishing components from same material as the aluminum building panels.
- .2 Finish: to match aluminum building panels.
- .3 Colour: to match colour with aluminum building panels.

2.7 SEALANT

- .1 Silicone sealant in accordance with Section 07 92 00.

2.8 FABRICATION

- .1 Machine fabricated all material in accordance with reviewed shop drawings with straight lines, square corners or smooth bends, free from twists, kinks, warps, dents, and other imperfections which may affect appearance or serviceability.

- .2 Provide reinforced panels as required to meet the tolerances specified above.
- .3 System shall have a flush appearance from the exterior with no reveal other than module joint width.
- .4 Panels shall be aligned with no lap or reveal other than joint width to permit expansion and contraction.
- .5 Thickness of the metal and details of assembly and support shall provide sufficient strength and stiffness to resist distortion of finish surface. Exposed edges and ends of metal shall be dressed smooth, free from sharp edges and with no uniform minimum radius corners. Connections and joints exposed to weather shall be constructed to exclude water.
- .6 Fasteners shall be concealed.
- .7 Back of panels shall be sealed to perimeter framing with continuous bead of silicone sealant.
- .8 All necessary holes shall be drilled and clip attachments applied before application of finish.
- .9 Trim and flashing shall be factory-fabricated ready for assembly.
- .10 Design and fabricate appropriate type, size, quantity and spacing of all sub-connectors, girts, fasteners and other anchorage devices as required to suit the specified standards.
- .11 Subgirts shall be perforated at regular intervals to permit drainage of cavity.

2.9 FINISH

- .1 Colour Coating: KYNAR® 500 or HYLAR® 5000 based Polyvinylidene Fluoride (PVDF) or Fluoro Ethylene – Alkyl Vinyl Ether (FEVE) resin in conformance with the requirements of AAMA 2605, consisting of a prime coat, barrier coat, colour coat, and clear top coat.
 - .1 Colour: as selected by the Consultant.

3 EXECUTION

3.1 INSPECTION

- .1 Surfaces to receive panels shall be even, smooth, sound, clean, dry and free from defects detrimental to work.

- .2 Notify the Consultant in writing of conditions detrimental to proper and timely completion of the work. Do not proceed with erection until unsatisfactory conditions have been corrected.
- .3 Surfaces to receive panels shall be structurally sound as determined by a registered Engineer.

3.2 INSTALLATION

- .1 Erect panels plumb, level, and true.
- .2 Attachment system shall allow for the free and noiseless vertical and horizontal thermal movement due to expansion and contraction for a material temperature range of -28.8°C to +82°C. Buckling of panels, opening of joints, undue stress on fasteners, failure of sealants or any other detrimental effects due to thermal movement will not be permitted.
- .3 Fabrication, assembly, and erection procedure shall account for the ambient temperature at the time of the respective operation.
- .4 Panels shall be erected in accordance with an approved set of shop drawings.
- .5 Anchor panels securely per engineering recommendations and in accordance with approved shop drawings to allow for necessary thermal movement and structural support.
- .6 Conform to panel fabricator's instructions for installation of concealed fasteners.
- .7 Do not install component parts that are observed to be defective, including warped, bowed, dented, abraded, and broken members.
- .8 Do not cut, trim, weld, or braze component parts during erection in a manner which would damage the finish, decrease strength, or result in visual imperfection or a failure in performance. Return component parts that require alteration to shop for re-fabrication, if possible, or for replacement with new parts.
- .9 Separate dissimilar metals and use gasketed fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.
- .10 Joints shall not be less than their dimensioned width or more than five percent (5%) greater than their dimensioned width at any location along their full length and shall not be wavy, out of line or of different width panel to panel.

- .11 Installed panels shall not deviate from overall plane or alignment more than 1.5mm (1/16 in) in 900mm (36 in). Adjacent panels shall not deviate from plane and alignment by more than 0.79mm (1/32 in) along their length.

3.3 FIELD QUALITY CONTROL

- .1 The manufacturer's or suppliers professional design engineer shall be responsible for production of shop drawings and shall provide periodic inspections during construction as required. Such inspections and associated costs shall be included in Bid Price.
- .2 At completion of the work, the manufacturer's or supplier's professional design engineer shall submit to the consultant copies of field review reports for each site visit made and a final signed and sealed letter of assurance of "professional field review" and "compliance" indicating that all aluminum building panels have been installed in accordance with the manufacturer's specifications, the standards specified herein and the final reviewed shop drawings.

3.4 CLEANING

- .1 If necessary, wash panels to remove surface dust, dirt, stains and marks on the panels caused by ambient environmental weather conditions and construction activities. Provide a clean installation of the work in accordance with section 01 74 00. Replace damaged or marred panels that cannot be fixed nor touch up accordingly to the approval of the consultant.
- .2 Use cleaners approved by the manufacturers of surfaces to be cleaned.
- .3 Protect panels from damage by other trades.
- .4 Remove tools, debris, equipment, and surplus materials from the site.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide prefinished metal siding for walls, as follows:
 - .1 Corrugated siding panels
 - .2 Corner and edge trims
 - .3 Fasteners
 - .4 Structural support
 - .5 Z-girt supports
 - .6 Installation

1.3 REFERENCES

- .1 ASTM A653/A653M; Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM A792/A792M; Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .3 ASTM A924/A924M; Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .4 ASTM A1008/A1008M; Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability.
- .5 ASTM-D523; Test Method for Specular Gloss.
- .6 ASTM-D822; Practice for Conducting Tests on Paint and Related Coatings and Materials using Operating Light -and water - Exposure Apparatus (Carbon-Arc Type) for Testing.

- .7 ANSI B18.6.4; Screws, Tapping and Metallic Drive, Inch Series, Thread Forming and Cutting.
 - .8 CSSBI 20M; Standard for Sheet Steel Cladding for Architectural, Industrial and Commercial Building Applications.
 - .9 CSA S16.1; Steel Structures for Buildings, Limit States Design.
 - .10 CSA-S136; Cold Formed Steel Structural Members.
- 1.4 SUBMITTALS
- .1 Samples
 - .1 Submit samples in accordance with Section 01 30 00.
 - .2 Submit duplicate 300mm x 300mm samples of siding material, of colour and profile specified.
 - .3 Submit full range of colour sample chips.
 - .2 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 30 00.
 - .2 Indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, metal furring, and related work.
 - .3 Work shall not commence until all samples and shop drawings have been successfully reviewed by the Consultant.
- 1.5 QUALITY ASSURANCE
- .1 Applicator Qualifications
 - .1 Work of this section shall be performed by mechanics having a minimum of 5 years documented experience in the installation of commercial metal siding. Submit proof of experience to Contractor.
 - .2 Installation
 - .1 Work shall be performed in strict accordance with manufacturer's printed instructions, and in accordance with all warranty requirements.
 - .3 Pre-installation Meeting
 - .1 Convene a pre-installation meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager),
 - .2 Installation Subcontractor (Site Foreman & Project Manager),
 - .3 Product Manufacturer and/or Distributor (Technical Representatives),
 - .4 Related Subcontractors (ie. Air Barrier)
- 1.6 SYSTEM DESCRIPTION
- .1 Design Requirements
 - .1 Use Limit States Design Principles using factored loads and resistances.

- .2 Refer to Structural drawings for loads. Load factors shall be in accordance with the National Building Code of Canada.
- .3 Deflection of sheet steel cladding components due to uniformly distributed loads (wind, snow) shall not exceed $L/90$ of the span for walls.
- .2 Performance Requirements
 - .1 All materials provided under this section shall meet or exceed CSSBI 20M.
 - .2 Appearance: Exposed fasteners in evenly spaced and aligned patterns as approved by the Contractor; exposed surfaces free of distortion, twist, waves and buckles.
 - .3 Structural Loads: resist positive and negative wind pressures expected in this geographical region with a maximum allowable deflection of $1/180$ of span. Components shall not vibrate when subjected to the effects of wind.
 - .4 Moisture control: prevent infiltration of water and snow into wall system. Provide means of draining space between insulation and exterior cladding.
 - .5 Thermal Movement: accommodate expansion and contraction of component parts without causing buckling, failure of joint seals, undue stress on fasteners and other detrimental effects.
 - .6 Structural Movement: accommodate movement between wall system and building structure caused by structural movement, without permanent distortion, racking of joints, breakage of seals or water penetration.
 - .7 Air/Vapour Seal: except where it is provided by another Section, provide continuous and uninterrupted air/vapour barrier against water vapour transmission and air movement effectively sealed at laps penetrations and terminations.

2 PRODUCTS

2.1 SYSTEM COMPONENTS

- .1 Thermal Isolation Clips: to Section 07 24 25.
- .2 Z-Girts: cold-rolled, commercial grade structural quality sheet steel (SS), minimum (18 gauge) 1.519mm base metal thickness; zinc-coated to ASTM A653/A653M, coating designation Z275.
- .3 Flashing & Trim: gauge, coating, and finish to match face sheet.
- .4 Insulation & Transition Membrane: to Section 07 21 29.

- .5 Fasteners: self-drilling, self-tapping, stainless steel, with colour-matched heads.
- .6 Prefinished Sheet:
 - .1 Sheet Steel: Cold-rolled, Grade 230 structural quality sheet steel, to ASTM A924/A924M minimum (24ga) 0.635mm base metal thickness; Zinc-Coated (Galvanized) & Aluminum-Zinc Alloy Coated (Galvalume) to ASTM A792, coating designation AZ 50.
 - .2 Finish: system shall be factory-applied on a continuous coil coating line. Top (exposed) side colour coated to dry film thickness of 17.5 to 22.5 microns over 6.25 to 8.75 micron prime coat, for total dry film thickness of 23.75 to 31.25 microns. Bottom (reverse) side primer coated, dry film thickness of 6.25 microns. Finish shall conform to all tests for adhesion, flexibility, and longevity specified by the coating supplier. Strippable film shall be applied to the topside of the painted coil to protect the finish during fabrication, shipping, and field handling.
 - .1 Bottom (Reverse Side): factory-applied, thermosetting, 2-coat silicon-modified polyester paint system; colour - primer grey.
 - .2 Top (Exposed Side): KYNAR® 500 or HYLAR® 5000 based Polyvinylidene Fluoride (PVDF) or Fluoro Ethylene – Alkyl Vinyl Ether (FEVE) resin in conformance with the requirements of AAMA 2605, consisting of a prime coat, and colour coat.
 - .3 Siding Profile/System:
 - .1 Profile: (8") 203mm wide Architectural Panel – Signature Series, by Havelock Metal Co., or approved equivalent.
 - .1 Thickness: 24 gauge G-90 Grade and AZ150 Grade A.
 - .2 Colour: Textured Matte Finish - Charcoal.
- .7 Flashing and Trim: Profiles and shapes as indicated on the drawings. Material thickness, colour, and finish to match siding sheet.

3 EXECUTION

3.1 EXAMINATION

- .1 Air Barrier
 - .1 Examine air barrier installation, and ensure that it is complete and ready for siding system installation. Report observed deficiencies to the Contractor prior to commencing installation.

3.2 INSTALLATION

- .1 General
 - .1 Install cladding in accordance with manufacturer's written instructions.

- .2 Maintain joints in exterior cladding, true to line, tight fitting, hairline joints.
- .3 Attach components in manner not restricting thermal movement.
- .4 Install Thermal Isolation Clips in accordance with Section 07 24 25.
- .2 Installation of Sub-Framing, And Insulation
 - .1 Pre-punch holes or pre-drill holes in Z-girts and tracks to accommodate fasteners.
 - .2 Position Z-girts directly over Thermal Isolation Clips before installation of fasteners.
 - .3 Completely install Thermal Isolation Clips and screws for first Z-girt / track. For subsequent girts:
 - .1 Fasten top spacer with single screw through Z-girt and spacer into substrate ensuring spacer can pivot for accurate alignment.
 - .2 Allow insulation installation before completing installation of remaining screws to secure Z-girt and Thermal Isolation Clips.
- .3 Siding Installation Sequencing
 - .1 Install Thermal Isolation Clips and Z-girts after completion and approval of air barrier transition membrane installation, but before sprayed insulation installation. Transition membrane and insulation by Section 07 21 29.
 - .2 Allow for cavity wall insulation installation.
 - .3 Following insulation installation and acceptance by the Contractor, install cap sheets with colour-matched screws to steel Z-girt support frame.
 - .4 Install continuous coping, outside corners, edgings, drip-cap, and other flashings as indicated, and as required to complete the siding installation.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

- A. The general conditions of the contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- B. The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- C. Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- D. Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- A. Provision of all labour, materials, equipment and incidental services necessary to provide a two ply modified bitumen roof system, including all associated roofing accessories, flashings and sealants.

1.3 RELATED SECTIONS

- A. Section 06 10 00 – Rough Carpentry
- B. Section 07 62 00 – Sheet Metal Flashing and Trim
- C. Section 07 92 00 – Joint Sealant

1.4 REFERENCES

- A. References, General: The most recent adopted versions of the following references apply to the Work of this Section.
- B. Asphalt Roofing Manufacturers Association/National Roofing Contractors Association (ARMA): www.asphaltroofing.org
 - 1. Quality Control Guidelines for the Application of Built-up Roofing

- C. ASTM International (ASTM): www.astm.org
- D. Canadian General Standards Board (CGSB): www.tpsgc-pwgsc.gc.ca/ongc-cgsb
- E. Canadian Roofing Contractors Association (CRCA): www.roofingcanada.com
- F. National Roofing Contractors Association: www.nrca.net
- G. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): www.smacna.org
- H. Underwriters Laboratories of Canada (ULC): www.ul.com/canada/eng/pages
 - 1. ULC - Fire Resistance Directory
 - 2. CAN/ULC-S102 - Surface Burning Characteristics of Building Materials and Assemblies
 - 3. CAN/ULC-S107 - Fire Tests of Roof Coverings
 - 4. CAN/ULC-S126 - Standard Method of Test for Fire Spread Under Roof-Deck Assemblies
 - 5. CAN/ULC-S701 - Thermal Insulation, Polystyrene, Boards and Pipe Covering

1.5 SYSTEM DESCRIPTIONS

- A. Roof assemblies are based on a conventional tow ply modified bitumen membrane adhered with SEBS asphalt and elastomeric flashing sheet flashing application. All plies are to be continuously mopped and finished with A SEBS asphalt flood coat and peastone.
- B. Roof System (R1) – Typical: Construction of the roof assembly from the deck upwards is as follows:
 - 1. Deck
 - 2. Underlayment Board
 - 3. Vapour Retarder
 - 4. Insulation (Isocyanurate total 88mm)
 - 5. Taper insulation sloped as per drawings)
 - 6. Stone Wool Insulation (125mm, two lifts of 62.5mm)
 - 7. Modified Bitumen Membrane (Two plies in SEBS Asphalt)
 - 8. SEBS Flood Coat w/Aggregate Surfacing

1.6 DEFINITIONS

- A. Roofing Terminology Definitions: ASTM D1079 and the following:

1. CRCA Roofing Specifications Manual.
2. CRCA Reference Manual.

1.7 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Conference: Prior to commencing Work, conduct at Project site.
1. Meet with Owner, testing and inspecting agency representative, roofing Installer, roofing manufacturer's representative, and installers of related work.
 2. Review installation methods and procedures, including manufacturer's written instructions and requirements of referenced standards.
 3. Review and finalize construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review structural loading limitations of roof deck during roofing operations.
 5. Review base flashings, edge conditions and terminations, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing.
 6. Review requirements of authorities having jurisdiction and requirements for insurance and certificates if applicable.
 7. Review temporary protection requirements for roofing.
 8. Review roof observation, inspection, and repair procedures.
 9. Examine deck substrate conditions and finishes for compliance with requirements.

1.8 ACTION SUBMITTALS

- A. Product Data: For each specified product.
- B. ULC-S107: Methods of Fire Tests for Roof Coverings: Class A
- C. Design calculations for wind uplift loads. As tested in compliance with CSA 123.21.

Roof Area	Wind Load
End Zone Width	2.22M
Corner	58psf
Edge	30psf
Field	23psf

1.9 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1. Include original letter from Manufacturer written for this Project indicating manufacturer's approval.

B. Contractor's Product Certificate: Notarized certificate, listing product names and numbers and manufacturers' names, indicating that products to be provided and the completed roofing system meet the requirements of the Contract Documents. Submit the following as attachments:

1. Test Reports based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency.
2. Evidence of compliance with performance requirements.
3. Statement indicating that proposed system components are compatible.

C. Warranties: Unexecuted copy of warranties.

D. Inspection Reports: Daily reports of Roofing Inspector. Include weather conditions, description of work performed, tests performed, defective work observed, and corrective actions taken to correct defective work.

1.10 CLOSEOUT SUBMITTALS

A. Maintenance Data in accordance with 01 78 00.

B. Warranties:

1. Manufacturer's and Installer's executed warranty documents. Submit prior to acceptance of Work.

1.11 QUALITY ASSURANCE

A. Quality Standards: Perform Work of this Section in accordance with the following:

1. CRCA Reference Manual.
2. NRCA Roofing Manual

B. Manufacturer Qualifications: A qualified manufacturer with minimum five years' experience in manufacture of specified products in successful use on similar projects and able to provide roofing system meeting specified requirements.

C. Installer Qualifications: A manufacturer-approved firm with minimum five 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, able to communicate verbally with Contractor and employees, and qualified by the manufacturer to furnish warranty of type specified.

- D. Roofing Inspector Qualifications: A technical representative of manufacturer not engaged in the sale of products and experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Roofing Inspector shall be one of the following:
1. An authorized full-time technical employee of the manufacturer.
 2. An independent party certified as a Registered Roof Observer by RCI, retained by the Contractor or the Manufacturer and approved by the Manufacturer.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original containers, dry, undamaged, with manufacturer's seals and labels intact.
- B. Store products in weather protected environment, clear of ground and moisture. Protect foam insulation from direct exposure to sunlight.
- C. Handle and store roofing materials and place equipment in a manner that does not result in permanent deflection of deck.

1.13 PROJECT CONDITIONS

- A. Weather Limitations: Comply with manufacturer's written instructions and warranty requirements.
- B. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is occurring.
- C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

1.14 WARRANTY

- A. Roof System Warranty: Warranties specified in this Section include the following components and systems specified in other sections supplied by the roofing system Manufacturer, and installed by the roofing system Installer:
 1. Sheet metal flashing and trim, including roof penetration flashings.

2. Manufactured copings, roof edge, counterflashings, and reglets.
 3. Roof curbs, hatches, and penetration flashings.
 4. Roof and parapet expansion joint assemblies.
 5. Metal roof, wall, and soffit panels and trim.
- B. Manufacturer's Warranty: Manufacturer's standard or customized form, in which manufacturer agrees to repair or replace components of roofing that fail in materials or workmanship within specified warranty period.
1. Manufacturer's warranty includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, and other components of roofing.
 2. Warranty Period: 20 years from date of Substantial Completion.
 3. Manufacturer to perform at no additional cost to the owner visual inspection, preventative maintenance and general housekeeping of roof in years 2, 5, 10 and 15 of the warranty period.
- C. Installer's Warranty: Roofing system Installer's warranty, on warranty form at end of this Section signed by Installer, covering the Work of this Section, including all components of roofing such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, roof pavers, and walkway products, for the following warranty period:
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products named in this Section were used to establish performance requirements for the project; additional manufacturers offering similar products may be incorporated into the work of this Section provided they meet performance requirements established by named products.

2.2 PERFORMANCE REQUIREMENTS

- A. Compatibility: Verify that roofing materials provided by the same manufacturer or are compatible with one another when provided by different manufacturers and as follows:
1. Roofing materials must be compatible with air and vapour retarder specified under Section 07 27 00. Provide cross-compatible connection membrane.

2. Provide written declaration to the Consultant that roofing materials and components are compatible with wall air and vapour retarder membranes

2.3 UNDERLAYMENT BOARD/VAPOUR RETARDER

- A. Fiberglass mat gypsum roof board manufactured to meet ASTM C1177, thickness: 13 mm. Dens Deck Prime by Georgia Pacific or approved alternate.
- B. Vapour Retarder: #15 organic felt, asphalt impregnated. Plies: 2
- C. Vapour Retarder Adhesive: Asphalt Type III

2.4 ROOFING MEMBRANE

- A. Base Ply: Smooth surfaced SBS modified reinforced with non-woven fiberglass scrim. Meet or exceed the requirements of ASTM D6163, Type III, Grade S. Basis of Design: Powerply Heavy Duty
 1. Thickness, minimum, 120 mil to ASTM D 5147.
 2. Low Temperature Flexibility, minimum, -18 Deg C, to ASTM D5147.
 3. Tensile Strength @ -18 Deg C, minimum, 977N MD, 977N XD, to ASTM 5147.
 4. Tear Strength. Minimum, 260lbf MD, 230 lbf XD, to ASTM 5147.
 5. Plies: 1
- B. Top Ply: Smooth surfaced SBS modified reinforced with and a glass reinforcing mat. Meet or exceed the requirements of ASTM D6163, Type I, Grade S. Basis of Design: Powerply Standard Smooth.
 1. Thickness, minimum, 80 mil to ASTM D 5147.
 2. Low Temperature Flexibility, minimum, -20 Deg C, to ASTM D5147.
 3. Tensile Strength @ 25 Deg C, minimum, 17kN/m MD, 15kN/m XD, to ASTM 5147.
 4. Tear Strength. Minimum, 120lbf MD, 90lbf XD, to ASTM 5147.
 5. Plies: 1

2.5 FLASHINGS

- A. Flashing Membrane: Flexible flashing membrane blend of EPDM/SBR reinforced with polyester woven scrim. Basis of Design: TRA Elastomeric Sheeting
 1. Breaking Strength, minimum, 1550N MD, 1330N XMD, to ASTM D751.
 2. Plies:1

3. Low Temperature Flexibility, minimum, -50 Deg C, to ASTM D2136.

B. Base Flashing: SBS modified sand/sand polyester/glass reinforced base sheet to ASTM D4601.

1. Tensile Strength @-18 Deg C, minimum, 835N MD, 790N XMD, to ASTM D5147.

2. Tear Strength, minimum, 340 N MD, 340 XMD, to ASTM D751.

3. Low Temp Flex, minimum, -40 Deg C, to ASTM D2136.

4. Plies:1

2.6 ADHESIVES

A. Vapour Retarder/Insulation Adhesive: Asphalt, type III, mopping grade in accordance with ASTM D 312.

B. Top pour/Interply Adhesive/ Flashing Adhesive/ Horizontal Stripping Adhesive: SEBS modified asphalt, elastomeric hot melt roofing adhesive to ASTM D 6152. Basis of Design: Thermastic 80.

1. Elongation, minimum, 800% to ASTM D 3960.

2. Elastic Recovery, minimum, 96% to ASTM D 412.

3. Low Temperature Flexibility, - 8 Deg C to ASTM D 3111.

C. Vertical Flashing Stripping Adhesive: Single component uv stable roof elastomer. Basis of Design: Polyroof LV.

1. Elongation @ 25 Deg C, minimum, 1000% to ASTM D 412.

2. Elongation @ -34 Deg C, minimum, 1001% ASTM D 412.

3. Tensile Strength, minimum, 205 kPa, ASTM D412.

4. Low Temperature Flexibility @ -40 Deg C, pass, ASTM D 3111.

5. Grade: Flashing/Trowel

2.7 ROOFING MEMBRANE ACCESSORIES

A. General: Auxiliary materials recommended by roofing manufacturer for intended use and compatible with roofing.

B. Stripping Reinforcement Fabric: non-shrinking, non-rotting, vinyl coated, woven glass bonded mesh.

C. Mastic Sealant: Polyisobutylene, plain or modified bitumen, nonhardening, nonmigrating, non skinning, and nondrying.

D. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

- E. Tapered Edge Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates designed for fastening roofing components to substrate, tested by manufacturer for required pullout strength, and acceptable to roofing manufacturer.
- G. Termination Bar: aluminum alloy, with pre punctured holes, as required by manufacturer.
- H. Miscellaneous Membrane Accessories: Flexible molded boots and collars, pourable sealers, preformed corners, in-seam sealants, and other accessories as required by manufacturer.
- I. Primer: Asphalt based primer to ASTM D 41.
- J. Detailing Sealant: High movement, single component, medium modulus, non-sag polyurethane sealant to meet or exceed the requirements of ASTM C920, Type S, Grade NS, Class 50.
- K. Insulation Adhesive (Stone Wool): Two-part low rise foam as approved by manufacturer and CSA for wind uplift testing.

2.8 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: Rigid, closed cell, polyisocyanurate foam core, laminated sides to a fiber reinforced facer. To meet ASTM C 1289, Type II, Class I, Grade 2.
 - 1. Layers: 1
 - 2. Total Thickness: 88mm (3.5").
- C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
- D. Mineral Wool: Rigid mineral wool coverboard, dual density and asphalt coated to ASTM C726. Basis of Design: Top Rock DD Plus by Rockwool.
 - 1. Top Layer Compressive Strength @10% Compression, 140kPa, to ASTM C1655.
 - 2. Total Thickness: 125mm
 - 3. Layers: 2 (62.5mm per layer)

- E. Tapered Insulation: High density isocyanurate by Posi Slope, Accuplane or approved equal.

2.9 SURFACING

- A. Top Pour: as per section 2.5.B
- B. Aggregate: 6mm to 12mm peastone aggregate, well rounded, opaque, non-porous material. Washed free of fines , moisture, debris and splinters.
- C. Precast Pavers (where indicated): Concrete, 50mm thick, 600mm x 600mm, textured wear pattern.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and site conditions, with Installer, for compliance with requirements, prior to commencing work.
 - 1. Verify surfaces and site conditions are ready to receive work.
 - 2. Verify deck is supported and secure.
 - 3. Verify that roof openings and penetrations are in place, curbs are set and braced, blocking, curbs, wood cants, and nailers are anchored to roof deck at penetrations and terminations, that wood nailers match insulation thickness, and roof drain bodies are properly installed.
 - 4. Verify deck surfaces are clean, dry, and free of snow or ice.
 - 5. Ensure parapet walls are completed and ready for flashing installation.
- B. Report: Provide written report to Owner indicating conditions that do not meet requirements.
- C. Proceed with installation once non-complying conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of substances and projections detrimental to roofing installation according to roofing manufacturer's written instructions.
- B. Prevent materials from entering roof drains and conductors and from contacting surfaces of other construction.
- C. Substrate-Joint Penetrations: Prepare joints as required to prevent asphalt and adhesives from penetrating joints, entering building, or damaging roofing components or other construction.

- D. Prime non-bituminous surfaces at rate required by manufacturer.
- E. Install cants at all vertical intersections in continuous bead of insulation adhesive.

3.3 INSTALLATION, GENERAL

- A. Install roofing membrane system components according to roofing manufacturer's written instructions, applicable referenced roofing system approval, and approved shop drawings.
- B. Cooperate with testing agencies and personnel engaged or required to perform services for installing roofing.

3.4 UNDERLAYMENT BOARD

- A. Install underlayment board in continuous pattern concealing entirety of steel deck. Mechanically fasten substrate board with a minimum of eight (8) fasteners per 1200mm x 2400mm board. Increase fastening at perimeters and corners as required.
- B. Install adjacent rows staggered by one half board length.
- C. Install boards free of warp, defect and damage. Only install boards that can be completely concealed by end of day.
- D. Seal all penetrations with stripping adhesive at underlayment level prior to applying roof membrane.
- E. Tape joints as required.

3.5 VAPOUR RETARDER

- A. Install two plies #15 felt over substrate board in adhesive applied at rate of 1.2kg/m².
- B. Install vapour retarder free of voids, defect and/or damage.
- C. Install vapour retarder continuously up walls to envelope insulation a minimum of 100mm.

3.6 INSULATION

- A. Install insulation boards free of warp, damage or defect.
- B. Install first course of polyisocyanurate insulation mechanically fastened to structural deck with a minimum of one fastener per 2.13ft².

- C. Install adjacent rows staggered by one half board length.
- D. Install tapered insulation in full moppings of asphalt applied at 1.2kg/m².
- E. Install two courses of stone wool insulation applied in beads of insulation adhesive applied 150mm O.C.
- F. All insulation boards to be installed as per manufacturer guidelines and free of damage.
- G. All insulation to be protected from moisture at all times.

3.7 ROOFING MEMBRANE INSTALLATION

- A. Start installation of roofing in presence of manufacturer's technical personnel.
- B. Coordinate installation of roofing to protect roofing system components and structure from exposure to precipitation.
- C. Membrane Sheet: Adhere to substrate according to membrane manufacturer's written instructions.
 - 1. Starting at low point apply base sheet into continuous application of base sheet in SEBS adhesive applied at rate of 1.2kg/m².
 - 2. Adhere membrane without wrinkles, blisters or fishmouths in a solid application of membrane field adhesive.
 - 3. Overlap membrane sheet at side laps 100mm and end laps 150mm, apply membrane field adhesive between salvage of underlying and top sheet for a complete seal.
 - 4. Ensure waterflow does not run against field membrane laps.
 - 5. Continue installation with application of top ply applied in continuous application of SEBS membrane adhesive applied at 1.2kg/m².
 - 6. Correct any deficiencies by cutting membrane and applying additional felt plies in moppings of membrane adhesive.
 - 7. Extend membrane to top of cant strips.
 - 8. Seal membrane around roof penetrations.
 - 9. Leave seams membrane exposed until inspected.

3.8 FLASHING AND STRIPPING INSTALLATION

- A. Flashings: Install one ply base flashing and one ply flexible flashing membrane throughout roof area.
 - 1. Prime substrates with primer as required.
 - 2. Flashing Sheet Application:

- a. Embed flashing sheet in a uniform coverage of Flashing Adhesive. Apply at rate of 1.2kg/m².
 3. Unless stated otherwise, extend base flashing up walls or parapets a minimum of 305 mm above insulation and 150 mm onto field of roofing.
 4. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
 5. Hand press flashing membrane into adhesive to ensure full adhesion is achieved.
 6. Reinforce flashing and flashing-to-membrane seams with a three course application of stripping mastic and reinforcement.
 7. Seal top termination of base flashing with a metal termination bar.
 8. Where flashing membrane extend and terminated vertically beyond 305mm, utilize cold-applied flashing adhesive.
 9. Reinforce vertical flashing seams with three course application of stripping adhesive and reinforcing mesh.
- B. Low Parapet Wall Flashing
1. Seal exposed joint between the wall and roof deck for airtight seal.
 2. Adhere elastomeric sheeting completely to flashing surface, cant, and roofing with flashing adhesive.
 3. Ensure complete bond and continuity without wrinkles or voids. Lap sheeting ends 100 mm and adhere with flashing adhesive.
 4. Extend elastomeric sheeting up and over parapet at least 38 mm and face nail with 38 mm common roofing nails, 200 mm OC.
- C. Flashing at Edges and Gutters
1. Fabricate and install new one-piece gutter with downspouts. Slope gutter to downspouts.
 2. Prior to setting and nailing horizontal flanges of gutter, uniformly trowel a 1.5 mm thick layer of cold flashing adhesive to roofing surface designated to receive metal flange.
 3. Nail flange to wood blocking 75 mm OC, staggered.
 4. Prime metal flange with asphaltic primer.
 5. Adhere sufficiently wide strip of elastomeric sheeting completely to flashing surface with flashing adhesive. Ensure complete bond and continuity without wrinkles or voids lap sheeting ends 100 mm and adhere with flashing adhesive. Elastomeric sheeting to cover gravel stop completely and overlap onto adjacent roof a minimum of 150 mm.
- D. Wall Flashing

1. Seal exposed joint between the wall and roof deck for airtight seal.
2. Adhere elastomeric sheeting completely to flashing surface, cant and roofing with flashing adhesive.
3. Ensure complete bond and continuity without wrinkles or voids. Lap sheeting ends 100 mm and adhere with flashing adhesive.
4. Elastomeric sheeting width: sufficient to extend at least 150 mm beyond toe of cant onto roof surface and 300 mm above the roof surface.
5. Secure top of elastomeric sheeting to vertical plane with termination bar. Mechanically fasten 300 mm OC. Overcoat bar with end lap stripping adhesive and membrane.

E. Building Expansion Joints

1. Fill joint with loose insulation.
2. Provide 13 mm (1/2 inch) thick plywood to top of wood blocking, secured one side only.
3. Apply foam rubber or 25 mm thick mineral fibre insulation to top of plywood.
4. Install elastomeric sheeting centred over expansion joint.
5. Fully adhere sheeting to horizontal and vertical blocking surfaces with flashing adhesive. Press sheeting into adhesive. Ensure complete bond and continuity without wrinkles or voids.
6. Lap sheeting ends 100 mm and adhere with flashing adhesive.

F. Expansion Joint at Wall

1. Extend vapour retarder from deck level up wall sufficiently and secure to wall.
2. Fill joint with loose insulation.
3. Install blocking, sheathing and compressible insulation as detailed on Drawings.
4. Adhere elastomeric sheeting completely to flashing surface, cant and roofing with flashing adhesive.
5. Ensure complete bond and continuity without wrinkles or voids. Lap sheeting ends 100 mm and adhere with flashing adhesive.
6. Elastomeric Sheetting Width: sufficient to extend at least 150 mm beyond toe of cant onto roof surface and 200 mm above the roof surface.
7. Secure top of elastomeric sheeting to vertical plane with a termination bar. Mechanically fasten 300 mm OC. Overcoat bar with end lap stripping adhesive and membrane.

G. Area Divider

1. Install elastomeric sheeting centred over area divider extending onto roof membrane a minimum of 150 mm beyond toe of cant on either side.
2. Fully adhere sheeting with flashing adhesive. Press sheeting into adhesive. Ensure complete bond and continuity without wrinkles or voids.
3. Lap sheeting ends 100 mm and adhere with flashing adhesive.

H. Control Joint

1. Install elastomeric sheeting centred over joint.
2. Fully adhere sheeting to horizontal and vertical blocking surfaces with flashing adhesive. Press sheeting into adhesive. Ensure complete bond and continuity without wrinkles or voids.
3. Lap sheeting ends 100 mm and adhere with flashing adhesive.

I. Curb Flashing

1. Fully adhere sheeting to horizontal and vertical blocking surfaces with flashing adhesive. Press sheeting into adhesive. Ensure complete bond and continuity without wrinkles or voids.
2. Mechanically fasten sheeting on top face of curb.
3. Lap sheeting ends 100 mm and adhere with flashing adhesive.
4. If membrane does not terminate to inside face of curb, secure top edge with a termination bar. Mechanically fasten 300 mm OC. Overcoat bar with end lap stripping adhesive and membrane.

J. Projection Flashing

1. Prime top and bottom side of aluminium flange.
2. Set flange in uniform bed of vertical grade stripping adhesive.
3. Apply flashing adhesive to prepared area and Provide aluminum base over pipe and set into the flashing adhesive.
4. Install penetration flashing in strict accordance with manufacturers written instructions.
5. Ensure seals are tight fit, caulking is not acceptable.
6. Provide clamp around pipe and rubber cap. Prime flange.
7. Install elastomeric sheeting with stripping ply adhesive and membrane.
8. Cover flange completely with 900mm x 900mm target patch.
9. Remove wrinkles and voids. Lap flashing ply ends 100 mm.

K. Equipment Stands (Pipe)

1. Provide 200 mm high sleeve flashing with 100 mm wide flange. Flange to extend completely around flashing periphery. Solder joints. Double solder vertical joints.
2. Nail flange to wood blocking minimum 75 mm OC; staggered.
3. Prime flange with asphaltic primer.
4. Install elastomeric sheeting to stand and roofing with continuous 1.5 mm thick application of flashing adhesive.
5. Sandwich top edge of sheeting between two layers flashing tape.
6. Secure top of sheeting with stainless steel drawband. Seal top of drawband and sheeting-to-pipe interface. Provide watershed and tool neatly.
7. Fabricate umbrella and install drawband; cover sleeve flashing minimum 75 mm. Install immediately above sleeve flashing. Tighten drawband.
8. Wipe clean top of umbrella and projection with metal cleaner. Prime surface with metal primer.
9. Seal projection-to-sheet metal interface. Provide watershed and tool neatly.
10. Install elastomeric sheeting with flashing adhesive and membrane.

L. Roof Drain

1. Install drain assembly in accordance with manufacturer's written installation guidelines.
2. Plug and seal drain to prevent water entry until service connection is completed.
3. Provide 900 x 900 mm size elastomeric sheeting reinforcement, centred over drain; and fully adhered with flashing adhesive. Remove wrinkles and entrapped air.
4. Apply mastic to exposed edge of membrane inside the drain opening.
5. Clamp flashing collar to drain in bed of flashing adhesive.
6. Trim excess sheeting within drain.

M. Stripping Installation:

1. Install stripping where metal flanges and edgings are set on roofing, and in sealing end laps and leading edges of flashings.

N. Scuppers:

1. Extend field membrane into throat of scupper in all directions.
2. Apply scupper flange into bed of vertical grade stripping mastic and fasten into place.

3. Conceal flange in all directions with flashing membrane adhered in cold-applied flashing adhesive.
4. Tie in leading edges with stripping adhesive and mesh.

3.9 ROOF SURFACING

- A. Ensure roof surface and clean, free of sediment and/or construction debris. Start installation of flood coat with presence of warranting manufacturer.
- B. Apply top pour of SEBS asphalt applied at rate of 2.6kg/m² over entire field membrane.
- C. Immediately broadcast clean peastone aggregate into SEBS asphalt top pour for full/even application.
- D. At areas where adhesion has not been achieved, sweep back loose aggregate prime surface and reapply top pour/peastone.
- E. At roof corners apply double flood coat and aggregate.
- F. Where indicated supply and install pavers.
- G. Where indicated supply and install or coordinate with sub trade the installation of vegetative roofing.

3.10 FIELD QUALITY CONTROL

- A. Roofing Inspector: Owner will engage a qualified roofing inspector to perform roof tests and inspections.
- B. Roofing Inspector: Contractor shall engage a qualified roofing inspector for a minimum of every other production day on site to perform roof tests and inspections and to prepare start up, interim, and final reports.
- C. Repair or remove and replace non-complying components of roofing. Retest to demonstrate compliance. Reports to be delivered to owner, architect, consultants and contractor minimum 24 hours after each inspection.

3.11 PROTECTING AND CLEANING

- A. Protect roofing from damage and wear during construction according to manufacturer's instructions.
- B. Correct deficiencies in or remove roofing that does not comply with requirements, repair substrates, and repair or reinstall roofing to a condition free

of damage and deterioration at time of Substantial Completion and according to warranty requirements.

- C. Clean overspray and spillage from adjacent construction.

SECTION ENDS

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide sheet metal flashing and trim, where not provided under other sections.

1.3 REFERENCE STANDARDS

- .1 Aluminum Association (AA); DAF-45, Designation System for Aluminum Finishes.
- .2 ASTM A526; Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.
- .3 ASTM A591; Specification for Steel Sheet, Cold-Rolled, Electrolytic Zinc-Coated.
- .4 ASTM A653/A653M; Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .5 ASTM A792/A792M; Specification for Steel Sheet, Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .6 ASTM B209; Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .7 ASTM D523; Test Method for Specular Gloss.
- .8 ASTM D822; Recommended Practice for Operating Light -and water - Exposure Apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer and related Products.

- .9 CSA B111; Wire Nails, Spikes and Staples.
- .10 Canadian Roofing Contractors Association.
- .11 CAN/CGSB-37.5; Cutback Asphalt Plastic Cement.

1.4 SAMPLES

- .1 Submit duplicate 50x50mm samples of each type of sheet metal material, colour and finish in accordance with Section 01 30 00.

2 PRODUCTS

2.1 SHEET METAL MATERIALS

- .1 Zinc coated steel sheet: 22ga. thickness, commercial quality to ASTM A653/A653M, with Z275 designation zinc coating.
- .2 Aluminum-zinc alloy coated steel sheet: to ASTM A792/A792M, commercial quality, with AZ180 coating, regular spangle extra smooth surface, chemically treated for unpainted finish not chemically treated for paint finish, 22ga. base metal thickness.

2.2 PREFINISHED SHEET MATERIALS

- .1 Prefinished Steel Sheet Flashing
 - .1 Prefinished steel with factory-applied PVDF Expressions Finish by Vicwest.
 - .1 Class F1S.
 - .2 Colours: as selected by the Consultant
 - .3 Specular gloss: 30 units +/- in accordance with ASTM D523.
 - .4 Coating thickness: not less than 22 micrometres.
 - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20 % to ASTM D822 as follows:
 - .1 Outdoor exposure period 2500 hours.
 - .2 Humidity resistance exposure period 5000 hours.
 - .2 Prefinished Aluminum Sheet
 - .1 Finish: factory applied coating;
 - .1 Fluoropolymer Paint: Kynar 500® based, factory-applied, thermosetting, 2-coat fluoropolymer paint system, to AAMA 605.2, consisting of a prime coat, and colour coat.
 - .1 Duranar, by PPG Canada Inc.
 - .2 Fluoropon, by The Valspar Corporation.
 - .3 Colours: as selected by the Consultant

2.3 ACCESSORIES

- .1 Isolation Coating: alkali resistant bituminous paint.

- .2 Plastic Cement: to CAN/CGSB-37.5.
- .3 Underlay for Metal Flashing: asphalt-laminated 3.6 to 4.5kg kraft paper.
- .4 Sealants: in accordance with 07 92 00.
- .5 Cleats: of same material, and temper as sheet metal, minimum 50mm wide. Thickness same as sheet metal being secured.
- .6 Fasteners: of same material as sheet metal, to CSA B111, self-drilling, self-tapping screws of sufficient length and thickness suitable for application.
- .7 Washers: same material as sheet metal, 1mm thick with rubber packings.
- .8 Touch-up Paint: as recommended by prefinished material manufacturer.

2.4 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work as indicated on the drawings and in accordance with CRCA details.
- .2 Fabricate aluminum flashings and other sheet aluminum work in accordance with Aluminum Association Aluminum Sheet Metal Work in Building Construction.
- .3 Form pieces in maximum practical lengths. Make allowance for expansion at joints. All flashing joints to be equally spaced in any given wall length.
- .4 Hem exposed edges on underside 12mm. 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.

2.5 COPINGS, FASCIAS, REGLETS & FLASHINGS

- .1 Form all copings, fascias, reglets & flashings to profiles indicated, from 22 ga prefinished sheet steel material.
- .2 Form base of wall flashing to profiles indicated, from 22 ga prefinished sheet steel material.

2.6 SCUPPERS

- .1 Form scuppers to profiles indicated, from (14 ga) 1.6mm prefinished aluminum material. Refer to Drawings.

3 EXECUTION

3.1 INSTALLATION

- .1 Install sheet metal work in accordance with CRCA recommended details and as detailed on the drawings.
- .2 Use concealed fastenings except where approved before installation.
- .3 Provide underlay under sheet metal. Secure in place and lap joints minimum 100mm.
- .4 Counter-flash roof membrane flashings at intersections of roof with vertical surfaces. Flash joints using S-lock seams forming tight fit over hook strips as detailed.
- .5 Lock end joints and caulk with sealant.
- .6 Caulk flashing at all reglets with sealant.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide intumescent thin film fire-resistive coating application, including;
 - .1 Surface preparation,
 - .2 Base coat (where required),
 - .3 Intumescent Fire-Resistive Coating, and
 - .4 Coloured Top Coat.

1.3 REFERENCE STANDARDS

- .1 CAN/ULC-S101; Fire Endurance Tests of Building Construction and Materials.
- .2 CAN/ULC-S102; Surface Burning Characteristics of Building Materials and Assemblies.
- .3 CAN4-S114; Determination of Non-Combustibility in Building Materials.
- .4 ASTM-E84; Test Method for Surface Burning Characteristics of Building Materials.
- .5 ASTM-E119; Test Methods for Fire Tests of Building Construction and Materials.
- .6 ASTM-E595; Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Out-gassing in a vacuum Environment.
- .7 ASTM-E605; Test Methods for Thickness and Density of Sprayed Fire-Resistive Materials (SFRM) Applied to Structural Members.
- .8 ASTM-E736; Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members.

- .9 ASTM-E759; Test Method for Effect of Deflection on Sprayed Fire-Resistive Materials Applied to Structural Members.
- .10 ASTM-E761; Test Method for Compressive Strength of Sprayed Fire-Resistive Materials Applied to Structural Members.
- .11 ASTM-D2240; Test Method for Rubber Property - Durometer Hardness.
- .12 ASTM-D2794; Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- .13 ASTM-D3960; Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.
- .14 ASTM-D4060; Test Method for Abrasion Resistance of Organic Coatings by the Taber Abrader.
- .15 Underwriters Laboratories Inc. (ULI); Fire Resistance Directory, Volume 1, current edition.
- .16 Intertek Testing Services / Warnock Hersey International, Inc. (ITS/WH); Directory of Listed Products, current edition.
- .17 Underwriters' Laboratories of Canada (ULC); List of Equipment and Materials, Fire Resistance, current edition.
- .18 Factory Mutual Research (FM); Approved Products Guide, current edition.

1.4 QUALITY ASSURANCE

- .1 Applicator Qualifications
 - .1 Work of this section shall be performed by applicators having a minimum of 2 years documented experience in the installation of intumescent thin film fire-resistive coating. Submit proof of experience to Consultant.
- .2 Installation
 - .1 Work shall be performed in strict accordance with manufacturer's printed instructions, and in accordance with all warranty requirements.
- .3 Pre-installation Meeting
 - .1 Convene a pre-installation meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager),
 - .2 Installation Subcontractor (Site Foreman & Project Manager),
 - .3 Product Manufacturer and/or Distributor (Technical Representatives),
 - .4 Related Subcontractors (ie. Mechanical and/or Electrical), and
 - .5 Consultant.

1.5 SYSTEM DESCRIPTION

- .1 Thin-film intumescent fire-resistive coating system shall provide a fire resistance rating:
 - .1 Columns: 2 hour for columns, in accordance with the following:
 - .1 UL Design No: X650.

1.6 SUBMITTALS

- .1 Submit manufacturer's product specifications including certification of compliance with the Contract Documents, as may be required by the Consultant.
- .2 Submit test results in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.
- .3 For assemblies not tested and rated, submit proposals based on related designs using accepted intumescent thin film fire-resistive coating design criteria.

1.7 SAMPLES

- .1 Submit duplicate 300mm x 300mm samples of final exposed finish of intumescent thin film fire-resistive coating in accordance with Section 01 30 00.

1.8 MOCK-UP

- .1 Site prepare mock-up of one column in intumescent thin-film fire-resistive coating in accordance with Section 01 30 00. Mock-up shall include all materials and layers representing complete coating system.
- .2 Notify Consultant upon completion of mock-up and request review.
- .3 Approved mock-up shall serve as the minimum standard of work for the balance of Intumescent Coating work. Approved mock-up may remain in place as part of the final work.
- .4 Rejected mock-up shall be removed and replaced with new material. Request re-inspection until approved by Consultant.

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- .2 Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer. Do not store in direct sunlight. Protect from freezing.
- .3 Store materials at a temperature not less than 10°C in a dry, protected area, off ground in original, undamaged, sealed containers with manufacturer's labels and seals intact.

1.10 SITE CONDITIONS

- .1 Substrate and ambient air temperature shall be in accordance with manufacturer's requirements.
- .2 Protect work area from windblown dust and rain. Protect adjacent areas from over spray.

- .3 Provide ventilation in areas to receive work of this section, during application and 24 hours (minimum) after application.
- .4 Temperature and Humidity Requirements: Maintain air temperature and relative humidity in spaces where products will be installed for a time period before, during and after installation as recommended by manufacturer.
- .5 Do not apply thin-film intumescent fire-resistive coating when temperature of substrate and/or surrounding air is below 10°C. Use electric heat if supplemental heat is required.
- .6 Maintain relative humidity of 40% to 60% in work area. Relative humidity must not exceed 75% throughout total period of application and drying for intumescent coating, and must not exceed 65% throughout application and drying for protective decorative finish coat.
- .7 Manufacturer's recommended temperature and humidity conditions must be maintained throughout the entire application and drying period until intumescent coating and basecoat are fully dried and top coated, including any interim period prior to application of top coat.

1.11 SEQUENCING AND SCHEDULING

- .1 Sequence work in conjunction with ceiling hanger tabs,, sprinkler pipes, HVAC systems and other mechanical systems.
- .2 Do not apply thin-film intumescent fire-resistive coating until concrete toppings and/or roofing applications have been installed.
- .3 Steel surfaces with less than 1 meter clear working access may necessitate the application of materials to inaccessible surfaces prior to erection of the finished steel members, either at the point of fabrication or on-site.

2 PRODUCTS

2.1 MATERIALS

- .1 Basecoat: non-intumescent base coat material for use in conjunction with UL Designs X640 and X644, ITS/WH Designs AD/CA 120-02 and AD/CA 180-02, ULC Designs Z609 and Z616, and Factory Mutual Column Protection Methods 3 and 4);
 - .1 A/D BASECOAT by A/D Fire Protection Systems.
 - .2 Bond-Seal by Cafco Industries Inc., Mississauga ON.
 - .3 Fire Finish 120+ CFP-SP-WB by Hilti Firestop.

- .4 Carboline equivalent by by StonCor Group Whitby ON.
- .2 Intumescent Fire-Resistive Coating: water-based, two-component, intumescent thin-film fire-resistive coating, labelled and listed;
 - .1 Hardness (Shore "D"): Durometer D81.8, 230°C.
 - .2 Surface Burning Characteristics (ASTM E84):
 - .1 Flame Spread: 0 -20,
 - .2 Smoke Development: 0-50, Class "A".
 - .3 Dry Weight: 2.2 kg/m² at 1.6mm dry.
 - .4 Cohesion / Adhesion (Bond or Tensile) (ASTM 736): 3.24 kgm² at 3mm dry.
 - .5 Compressive strength (ASTM E761): 7.6MPa at 10 % deformation.
 - .6 Impact Resistance (ASTM D2794): 1.4 kg-m (direct) at 1.6mm.
 - .7 Abrasion Resistance (ASTM D4060): 508 cycles at 1.6mm dry.
 - .8 Acceptable Products;
 - .1 CAFCO® Sprayfilm™ WB 3; by Cafco Industries Inc., Mississauga ON
 - .2 A/D FIREFILM®II; by A/D Fire Protection Systems Inc., Scarborough ON.
 - .3 Fire Finish 120+ CFP-SP-WB by Hilti Firestop.
 - .4 Carboline Nullifire®607; by StonCor Group Whitby ON.
- .3 Top Coat: one component, siliconized alkyd colour coating; colour as selected by the Consultant;
 - .1 Acceptable Products;
 - .1 CAFCO® Topseal; by Cafco Industries Inc., Mississauga ON,
 - .2 Equivalent by A/D, Carboline or Hilti.
- .4 Primers: Solvent-based (xylene), short oil alkyd/zinc phosphate, one coat primer.

3 EXECUTION

3.1 EXAMINATION

- .1 Examine surfaces to receive work of this Section and report any defects which may affect the application. Identification marking of steel components must be by wax crayon to facilitate ease of removal prior to application of intumescent coating.
- .2 Verify that substrate surfaces are ready to receive work. Commercial Blast Cleaning (SSPC-SP6/NACE No.3) is required for minimum surface preparation. Weld flashes shall be ground smooth prior to commencement of application.
- .3 Verify that all clips, hangers, sleeves and similar devices have been attached. Confirm compatibility of surfaces to receive intumescent coating. Steel surfaces must be primed with a compatible primer.

- .4 Beginning of installation means acceptance of substrate.
- .5 Verify substrate and workspace temperature and humidity conditions are in accordance with manufacturer's recommendations.

3.2 PREPARATION

- .1 Substrate shall be free of material which would impair bond.
- .2 Verify that painted substrate are compatible and have suitable bonding characteristics to receive intumescent coating. Remove incompatible materials.
- .3 Ensure that surface mounted conduits and fixtures, and any other items required to penetrate intumescent coating, are placed before installation.
- .4 Ensure that ductwork, piping, mechanical equipment, or other items which would interfere with application of intumescent coating are not positioned until work of this section is completed.
- .5 Remove all existing paint from steel surfaces to receive intumescent coating.
- .6 Provide drop sheets or other protection to adjacent areas or surfaces not to receive intumescent coating .
- .7 Mask all adjacent surfaces to prevent over spray or contamination.

3.3 APPLICATION

- .1 General
 - .1 Apply products in accordance with manufacturer's instructions in sufficient thickness to achieve required fire resistance rating. Spray application is recommended. Base Coat (where required) is to be applied by spray only. Apply decorative colour finish according to manufacturer's recommendations.
- .2 Priming
 - .1 Apply Intumescent Coating and Base Coat only to primed surfaces. Use only primer as approved by the manufacturer. Follow primer manufacturer's instructions.
- .3 Application Rates and Thickness Measurements
 - .1 Comply with fire test designs or manufacturer's thickness selection tables for determination of dry film thickness of Intumescent Coating and Base Coat (where required) for size of steel element to be protected, and for required fire resistance rating (s). Apply Top Coat.

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- .2 Apply Intumescent Coating at a maximum rate of 0.76mm wet or approximately 0.58mm dry per coat. Apply Base Coat (where required) at a maximum rate off 1.52mm wet per coat.
 - .3 Final dry film thickness must be measured with a dry-film thickness gauge. Do not apply Top Coat until it has been determined that the required dry film thickness of Intumescent Coating and Base Coat (where required) have been provided.
 - .4 Application
 - .1 Spray Equipment: Use spray application for best coverage, finish and appearance.
 - .1 For Intumescent Coating, use an airless sprayer capable of 20685kPa pressure, minimum, without surging.
 - .2 For Base Coat, use sprayer capable of 27580kPa pressure, minimum, without surging. Remove all filters except pump filter.
 - .3 For Intumescent Coating use a 3/17 to 4/23 size, heavy-duty type, self-cleaning (reversible) tip.
 - .4 For Base Coat, use a 0.58mm tip.
 - .5 Use a 0.38mm tip for Top Coat.
 - .6 Adjust pressure and distance between tip and surface to minimize orange peel. Adjust fan width to minimize over spray.
 - .2 Hand Application: Use a brush recommended for use with latex paint and a low pile roller to apply Intumescent Coating. Use a China bristle brush or roller to apply Top Coat. Apply Base Coat by spray only.
 - .3 Handling: When applying by brush or roller, work from a small container, mixing frequently. Keep original pail tightly closed with the surface of the material covered by the plastic sheet provided.
 - .4 Drying and Recoat Time: Drying time will vary with temperature and humidity conditions. Apply next coat of Base Coat only after previous coat is dry.
 - .5 Top Coat Application

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- .1 A minimum of 24 hours is recommended between application of the final coat of Intumescent Coating and application of Top Coat. Recommended site conditions must be maintained for any interim period after final coat of Intumescent Coating and until Top Coat has been applied and dried. Intumescent Coating must be dry before application of Top Coat. Do not apply Top Coat until it has been determined that the required dry film thickness of Intumescent Coating has been provided.
 - .2 Apply Top Coat to a minimum dry film thickness of 0.05-0.10mm.
 - .6 Patching
 - .1 Patch and repair any fire resistive coating that has been damaged in accordance with patching recommendations of material manufacturer. If coating becomes damaged, rebuild thickness by spray or brush. Fill small areas with trowel. When dry, smooth and finish with Top Coat to match.
 - 3.4 INSPECTION AND TESTING
 - .1 The intumescent coating basecoat application shall be tested for dry film thickness (DFT) in accordance with ASTM E605 tested assembly requirements, and manufacturer's specifications.
 - .2 The cost of inspection and testing shall be paid by the Owner.
 - 3.5 PATCHING
 - .1 All patching of and repair to intumescent coating due to damage by other trades, shall be performed by this section and paid for by the trade responsible for the damage.
 - 3.6 CLEANING
 - .1 Remove intumescent coating material from all adjacent materials not designated to receive intumescent coating application.
 - .2 Upon completion of the intumescent coating work, promptly remove all equipment, protection sheets, and excess materials from the site.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide firestop products and systems intended to act as a firestop and smoke seal within fire resistive wall and floor assemblies.
- .2 Firestop systems shall be used in locations including, but not limited to, the following:
 - .1 Penetrations through fire resistance rated floor and roof assemblies including both empty openings and openings containing penetrants.
 - .2 Penetrations through fire resistance rated wall assemblies including both empty openings and openings containing penetrants.
 - .3 Membrane penetrations in fire resistance rated wall assemblies where items penetrate on side of the barrier.
 - .4 Joints between fire resistance rated assemblies.
 - .5 Perimeter gaps between rated floors/roofs and an exterior wall assembly.
- .3 Firestops and smoke seals within mechanical and electrical assemblies (i.e. inside ducts, dampers and bus ducts) shall be provided as part of the work of those trades.
- .4 Firestops and smoke seals around the outside of such mechanical and electrical assemblies, where they penetrate fire separations, shall form part of the work of this section.

- .5 Firestop systems provide for the Work must be from one manufacturer only.

1.3 QUALITY ASSURANCE

.1 Manufacturer/Fabricator

- .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

.2 Installation/Application

- .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.

.3 Documentation

- .1 If requested by the Design-Builder, submit documentation to support the competency of firms and personnel.

.4 Pre-application Meeting

- .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

1.4 REFERENCE STANDARDS

- .1 ASTM E84-01; Standard Test Method For Surface Burning Characteristics of Building Materials.
- .2 ASTM E119; Methods of Fire Tests of Building Construction and Materials.
- .3 ASTM E814-00; Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- .4 ASTM E1399-97 (2000); Test Method for Cyclic Movement and Measuring Minimum and Maximum Joint Width.
- .5 ASTM E1966-00; Test Method For Resistance of Building Joint Systems.
- .6 UL 263; Fire Tests of Building Construction and Materials.
- .7 UL 723; Surface Burning Characteristics of Building Materials.
- .8 UL 1479; Fire Tests of Through-Penetration Fire Stops.
- .9 UL 2079; Tests for Fire Resistance of Building Joint Systems.
- .10 ULC-S115-1995 (R2001); Fire Tests of Firestop Systems.

- .11 CAN/ULC-S102-1988 (R2000); Surface Burning Characteristics of Building Materials and Assemblies.
- .12 Underwriters Laboratories of Canada; List of Equipment and Materials - Fire Resistance.
- .13 Underwriters Laboratories Inc.; Fire Resistance Directory – Volume 2.
- .14 Intertek Testing Services; Directory of Listed Building Products.
- .15 Factory Mutual Research (FM); FM Approval Standard of Firestop Contractors – Class 4991.
- .16 Omega Point Laboratories (OPL); Building Products, Materials & Assemblies – Volume II.

1.5 DEFINITIONS

- .1 Firestop: The use of a material or combination of materials in a fire-rated structure (wall or floor) where it has been breached, so as to restore the integrity of the fire rating on that wall or floor.
- .2 System: The use of a specific firestop material or combination of materials in conjunction with a specific wall or floor construction type and specific penetrant(s).
- .3 Barrier: Any bearing or non-bearing wall or floor that has an hourly fire and smoke rating.
- .4 Through-Penetration: Any penetration of a fire-rated wall or floor that completely breaches the barrier.
- .5 Membrane-Penetration: Any penetration in a fire-rated wall that breaches only one side of the barrier.
- .6 Fire Resistive Joint: Any gap, joint, or opening, whether static or dynamic, between two fire rated barriers including where the top of a wall meets a floor; wall edge to wall edge applications; floor edge to floor edge configurations; floor edge to wall.
- .7 Perimeter Barrier: Any gap, joint, or opening, whether static or dynamic, between a fire-rated floor assembly and a non-rated wall assembly.

1.6 PERFORMANCE REQUIREMENTS

- .1 Penetrations: Provide through-penetration firestop systems that are produced and installed to resist the spread of fire, passage of smoke and other hot gases according to requirements indicated, to restore the original fire-resistance rating of assembly penetrated.
- .2 Provide and install complete penetration firestop systems that have been tested and approved by nationally accepted testing agencies per ASTM E814, UL 1479, or ULC-S115 fire tests in a configuration that is representative of field conditions.

- .3 F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, to ASTM E814, UL 1479, or ULC-S115 but not less than one (1) hour or the fire resistance rating of the assembly being penetrated.
- .4 FT-Rated Systems: Provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, to ASTM E814, UL 1479, or ULC-S115, where required by the Building Code.
- .5 FH-Rated Systems: Provide through-penetration firestop systems with H-ratings indicated, as well as F-ratings, to ASTM E814, UL 1479, or ULC-S115, where required by the Building Code.
- .6 FTH-Rated Systems: Provide through-penetration firestop systems with H-ratings indicated, as well as F-ratings and T-ratings, to ASTM E814, UL 1479, or ULC-S115, where required by the Building Code.
- .7 For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
- .8 For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- .9 Fire Resistive Joints: Provide joint systems with fire resistance assembly ratings indicated, as determined by UL 2079 (ASTM E1399 and E1966), but not less than the fire resistance assembly rating of the construction in which the joint occurs. Firestop assemblies must be capable of withstanding anticipated movements for the installed field conditions.
- .10 For firestop assemblies exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.
- .11 For floor penetrations exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
- .12 Firestop products shall have flames spread ratings less than 25 and smoke-developed ratings less than 450, to ASTM E 84 or CAN/ULC-S102.
- .13 Where there is no specific third party tested and classified firestop system available for an installed condition, the firestop contractor shall obtain from the firestop material manufacturer an Engineering Judgment (EJ) to be submitted to the Design-Builder and authorities having jurisdiction for approval prior to installation. The EJ shall follow International Firestop Council (IFC) guidelines.

1.7 MOCK-UP

- .1 Prepare sample joints for approval by the Design-Builder, representative of each type of firestop condition in accordance with Section 01 30 00.
- .2 Where not approved by the Design-Builder, remove and replace sample joints to the satisfaction of the Design-Builder.
- .3 Approved installations may become part of the finished work.

1.8 SUBMITTALS

- .1 Consolidated List: Provide a consolidated list of all firestopping Products to be used for the Project, and their applications, including all those provided by Mechanical and Electrical Subcontractors.
- .2 Product Data: For each type of firestop product selected. Certify that firestop materials are asbestos free and contain volatile organic compounds (VOC's) within limits of the local jurisdiction.
- .3 Design Listings: Submit system design listings, including illustrations, from a qualified testing and inspecting agency that is applicable to each firestop configuration.
- .4 Where there is no specific third party tested and classified firestop system available for a particular configuration, the firestop contractor shall obtain from the firestop material manufacturer an Engineering Judgment (EJ) for submittal.
- .5 Qualification Data: For firms and persons specified under Quality Assurance to demonstrate their capabilities and experience. Submit document from manufacturer wherein manufacturer recognizes the installer as qualified.

1.9 ENVIRONMENTAL CONDITIONS

- .1 Install firestops when ambient or substrate temperatures are within limits permitted by the manufacturer's written instructions. Do not install firestops when substrates are wet due to rain, frost, condensation, or other causes.
- .2 Ventilate per the manufacturers written instructions on the product's Material Safety Data Sheet.

1.10 COORDINATION

- .1 Coordinate construction of openings and penetrating items to ensure that firestop assemblies are installed according to specified requirements.
- .2 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- .3 Do not conceal firestop installations until the Owner's inspection agency or Authorities Having Jurisdiction have examined each installation.

- .4 Schedule firestop work after installation of penetrants but prior to concealing the openings.

1.11 EXTENDED WARRANTY

- .1 Submit a warranty of the firestop installation specified in this Section covering a period of an additional two years beyond the expiration of the warranty period specified in the General Conditions of the Contract, including materials and application. Replacement of firestop shall include removal of defective materials, preparation for and application of new material, and the repair and making good of damaged adjacent materials.
- .2 "Defective" firestop installation shall include; joint leakage, hardening, cracking, crumbling, melting, bubbling, shrinkage, running, sagging, loss of adhesion, loss of cohesion, and staining of adjacent finished materials or surfaces.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 3M Fire Protection Products
- .2 A/D Fire Protection
- .3 Hilti Firestop Systems
- .4 Grace Construction Products
- .5 TREMstop Firestopping Systems

2.2 MATERIALS

- .1 Firestop And Smoke Seal Systems: in accordance with ASTM E814, UL 1479, or ULC-S115, asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke, and gases to ASTM E814, UL 1479, or ULC-S115, and not to exceed opening sizes for which they are intended.
- .2 Service Penetration Assemblies: certified in accordance with ASTM E814, UL 1479, or ULC-S115 and listed in testing laboratory directory.
- .3 Service Penetration Firestop Components: certified in accordance with ASTM E814, UL 1479, or ULC-S115 and listed in testing laboratory directory.
- .4 Fire resistance rating of installed firestop assemblies shall be in accordance with design requirements, and requirements of Ontario and National Building Codes.

- .5 Primers: to Firestop manufacturer's recommendation for specific material, substrate, and end use.
- .6 Intumescent Firestop Sealants and Caulks
 - .1 Grace FlameSafe FS1900.
 - .2 Hilti FS-One.
 - .3 A/D FIREBARRIER Intumescent Caulk.
 - .4 3M Fire Barrier CP 25WB+ Caulk.
 - .5 TREMstop IA by, TREMstop Firestopping Systems.
- .7 Elastomeric Sealant
 - .1 Grace FlameSafe FS1900, FS900+.
 - .2 Hilti CP601S.
 - .3 A/D FIREBARRIER Seal/Seal NS.
 - .4 3M Fire Barrier Sealant 2000 and 2000N/S.
 - .5 Fyre-Sil/Fyre-Sil S/L by, TREMstop Firestopping Systems.
- .8 Joint Spray
 - .1 Grace FlameSafe FS3000.
 - .2 Hilti CP672.
 - .3 A/D FIREBARRIER SprayMastic.
 - .4 3M FireDam Spray 200.
 - .5 TREMstop Acrylic SP by, TREMstop Firestopping Systems.
- .9 Firestop Putty
 - .1 Grace FlameSafe FSP1000 Putty & FSP1077 Putty Pads.
 - .2 Hilti CP617/617L Putty Pads, & CP618 Putty Stick.
 - .3 A/D FIREBARRIER Putty.
 - .4 3M Fire Barrier Moldable Putty+.
 - .5 TREMstop MP by, TREMstop Firestopping Systems.
- .10 Firestop Devices
 - .1 Grace FlameSafe FSWSD Collar, FSIS Intumescent Sleeve.
 - .2 Hilti CP642/643 Collar.
 - .3 A/D FIREBARRIER Collar/Sleeve.
 - .4 3M Fire Barrier RC-1 Restricting Collar.
 - .5 Fyre-Can/Fyre-Can Sleeve by, TREMstop Firestopping Systems.
- .11 Wrap Strips
 - .1 Grace FlameSafe FSWS 100/150.
 - .2 Hilti CP645.
 - .3 AD FIREBARRIER Wrap Strip.
 - .4 3M FS-195+.
 - .5 TREMstop WS by, TREMstop Firestopping Systems.
- .12 Firestop Mortars
 - .1 Grace FlameSafe FSM Mortar.
 - .2 Hilti FS635 Trowelable Compound.
 - .3 A/D FIREBARRIER Mortar.
 - .4 3M Fire Barrier Mortar.

- .5 TREMstop Fire Mortar by, TREMstop Firestopping Systems.
 - .13 Firestop Bags/Pillows/Blocks
 - .1 Grace FlameSafe Bags, FlameSafe Pillows.
 - .2 Hilti FS657 Fire Block.
 - .3 AD FIREBARRIER Pillows.
 - .4 3M Fire Barrier Pillows.
 - .5 TREMstop PS by, TREMstop Firestopping Systems.
 - .14 Forming/Damming Materials: Mineral Wool or other type as per manufacturer's recommendations.
 - .15 Accessories: Provide components for each firestop system that are needed to install fill materials and to comply with Performance Requirements. Use only approved components specified by the firestop manufacturer for the firestop systems indicated. Accessories include, but are not limited to the following items:
 - .1 Permanent forming/damming/backing materials, including the following:
 - .2 Mineral wool fiber insulation.
 - .3 Foams or sealants used to prevent leakage of fill materials in liquid state.
 - .4 Fire-rated form board.
 - .5 Polyethylene/polyurethane backer rod.
 - .6 Rigid polystyrene board, and other temporary forming materials.
 - .7 Substrate primers.
 - .8 Steel sleeves.
 - .16 All firestop products and systems shall be designed and installed so that the basic sealing system will allow the full restoration of the thermal and fire resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed.
- 2.3 MIXING
- .1 For those products requiring mixing before application, comply with firestop manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.
- 3 EXECUTION**
- 3.1 EXAMINATION
- .1 Examine substrates and conditions for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.
 - .2 Proceed with installation only after unsatisfactory conditions have been corrected.

- .3 Verify that all pipes, conduits, cables, and/or other items which penetrate fire-rated construction have been permanently installed prior to installation of firestops.

3.2 PREPARATION

- .1 Surface Cleaning: Clean out openings immediately before installing firestop systems to comply with written recommendations of firestop manufacturer and the following requirements:
 - .1 Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of firestop systems.
 - .2 Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestop systems. Remove loose particles remaining from cleaning operation.
 - .3 Remove laitance and form-release agents from concrete.
- .2 Firestop shall be installed before fireproofing where bonding of firestop to metal deck is required.
- .3 Firestop must precede installation of insulation around pipes and ducts penetrating fire separation.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces.

3.3 INSTALLATION

- .1 General
 - .1 Install firestop and smoke seal material and components in accordance with certification and manufacturer's instruction.
 - .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separations.
 - .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength to maintain their integrity.
 - .4 Tool or trowel exposed surfaces to a neat smooth finish.
 - .5 Remove excess compound promptly as work progresses and upon completion.
- .2 Penetration Firestop Systems

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- .1 Install through-penetration firestop systems to comply with Performance Requirements in Part 1 and firestop manufacturer's written installation instructions and published drawings for products and applications indicated.
 - .2 Apply firestops in accordance with listed system designs or manufacturer's EJ per the manufacturer's installation instructions.
 - .3 Install forming/damming/backing materials and other accessories required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire resistance ratings required.
 - .4 Install fill materials for firestop systems by proven techniques to produce the following results:
 - .1 Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - .2 Apply materials so they fully contact and adhere to substrates formed by openings and penetrating items.
 - .3 For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
- .3 Joint Firestop Systems
- .1 Install fire resistive joint firestop systems to comply with Performance Requirements in Part 1 and firestop manufacturer's written installation instructions and published drawings for products and applications indicated.
 - .2 Apply firestops in accordance with listed system designs or manufacturer's EJ per the manufacturer's installation instructions.
 - .3 Install joint forming/damming materials and other accessories required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths of installed firestop material relative to joint widths that allow optimum movement capability and achieve fire resistance ratings required.
 - .4 Install fill materials for firestop systems by proven techniques to produce the following results:
 - .1 Fill joint as required to achieve fire-resistance ratings indicated.
 - .2 Apply materials so they fully contact and adhere to substrates forming the openings.
 - .3 Completely fill recesses provided for each joint configuration.
 - .4 Tool non-sag firestop materials after their application and prior to the time skinning begins. Use tooling agents approved by the firestop manufacturer.

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- .4 Perimeter Barrier Firestop Systems
 - .1 Install perimeter barrier firestop systems to comply with Performance Requirements in Part 1 and firestop manufacturer's written installation instructions and published drawings for products and applications indicated.
 - .2 Apply firestops in accordance with listed system designs or manufacturer's EJ per the manufacturer's installation instructions.
 - .3 Install metal framing, curtain wall insulation, mechanical attachments, safing materials and firestop materials as applicable within the system design.
 - 3.4 INSPECTION
 - .1 Notify Design-Builder when installation is complete and ready for inspection, and prior to concealing or enclosing firestop materials and service penetration assemblies.
 - 3.5 TOLERANCES
 - .1 The following shall regulate sizing of service penetrations:
 - .1 Mechanical and Electrical shall sleeve single, circular penetrants, except in fire resistance rated gypsum board.
 - .2 Multiple penetrations of circular penetrants shall be considered such if the penetrants are not further than 102mm apart.
 - .3 Forming of multiple penetrations and single penetrants in fire resistance rated gypsum board assemblies shall be created by respective trades by forming a square or rectangular opening around the penetrants. The edges of the opening shall be covered in gypsum board
 - .4 Perimeter clearance shall be 13mm to 25mm for single penetrants, or 13mm to 25mm around outer penetrants in multiple penetrations.
 - .5 Penetrations of square or rectangular configuration shall be constructed as specified above. Perimeter clearance shall be 40 to 50mm.
 - 3.6 SCHEDULE
 - .1 Non-Service Penetrations Through Vertical Fire Separations Consisting Of Masonry, Concrete, Or Gypsum Board/Stud Construction;
 - .1 Elastomeric seal and backup/forming material.
 - .2 Firestop system rating: **F**.

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- .2 Edge Of Floor Slabs At Curtain Wall Or Precast Concrete Panel Assemblies;
 - .1 Self-leveling elastomeric seal and backup/forming material.
 - .2 Firestop system rating: **F**.

 - .3 Voids At Perimeter Edges Of Vertical Fire Separations Consisting Of Masonry, Concrete, Or Gypsum Board/Steel Stud Construction;
 - .1 Elastomeric seal and backup/forming material.
 - .2 Firestop system rating: **F**.

 - .4 Intersection Of Masonry And Gypsum Board/Steel Stud Fire Separations;
 - .1 Elastomeric seal and backup/forming material.
 - .2 Firestop system rating: **F**.

 - .5 Control And Deflection Joints In Fire Separations;
 - .1 Elastomeric seal and backup/forming material.
 - .2 Firestop system rating: **F**.

 - .6 Non-Service Penetrations Through Horizontal Fire Separations And Fire-Resistance Rated Floor Slabs, Ceilings, And Roofs;
 - .1 Self-leveling elastomeric seal and backup/forming material.
 - .2 Firestop system rating: **F**.

 - .7 Openings And Sleeves Installed For Future Use In Fire Separations;
 - .1 Elastomeric seal and backup/forming material.
 - .2 Firestop system rating: **FH**.

 - .8 Service Penetrations Around Mechanical Ductwork And Noncombustible Piping, Rigid Electrical Conduit And Other Assemblies Penetrating Fire Separations;
 - .1 Elastomeric seal and backup/forming material.
 - .2 Firestop system rating: **F**.

 - .9 Service Penetrations Around Mechanical Ductwork And Noncombustible Piping, Rigid Electrical Conduit And Other Assemblies Penetrating Firewalls;
 - .1 Elastomeric seal and backup/forming material.
 - .2 Firestop system rating: **FT**.

 - .10 Service Penetrations Around Combustible Piping Penetrating Fire Separations;
 - .1 Intumescent mastic collar.
 - .2 Firestop system rating: **F**.

- .11 Service Penetrations Around Multiple Flexible Cables Penetrating Fire Separations;
 - .1 Removable intumescent bags/pillows, or intumescent cable sleeve systems.
 - .2 Firestop system rating: **FT**.

- 3.7 CLEANUP
 - .1 Remove excess materials and debris from site, and clean adjacent surfaces immediately after application.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide caulking and sealing of joints between building components, including joint preparation.
 - .1 Exterior Joints
 - .1 Perimeter of metal frames in exterior walls
 - .2 Joints between dissimilar materials
 - .3 Full length of door thresholds
 - .4 Control and expansion joints
 - .2 Interior Joints
 - .1 Perimeter of metal frames in interior walls
 - .2 Joints between dissimilar materials
 - .3 Full length of door thresholds
 - .4 Control and expansion joints
 - .5 Perimeter of plumbing fixtures
 - .6 Perimeter of fixed equipment
 - .7 Acoustic sealants

1.3 REFERENCE STANDARDS

- .1 ASTM C920; Standard Specification for Elastomeric Joint Sealants.

- .2 CAN/CGSB-19-GP-5M; Sealing Compound, One Component, Acrylic Base, Solvent Curing.
- .3 CAN/CGSB-19-GP-14M; Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
- .4 CAN/CGSB-19.17; Sealing Compound, One Component, Acrylic Emulsion Base.
- .5 CAN/CGSB-19.13; Sealing Compound, One Component, Elastomeric, Chemical Curing.
- .6 CAN/CGSB-19.24; Sealing Compound, Multi-Component, Chemical Curing.

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor(Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

1.5 MOCK-UP

- .1 Test sealant in contact with samples of materials to be caulked to ensure that proper adhesion will be obtained and no staining of the material will result. Prepare sample joints at the site of each type of sealant for each joint condition to provide mock-up as specified in Section 01 30 00.

1.6 SUBMITTALS

- .1 Submit samples of sealants and backing materials.
- .2 Submit product list with manufacturer's product name for each sealant to be used for this project, along with recommendations for use of the sealant, before commencing joint sealing.

1.7 ENVIRONMENTAL CONDITIONS

- .1 Apply sealants only to completely dry surfaces, and at air and material temperatures above minimum established by manufacturer's specifications.

1.8 EXTENDED WARRANTY

- .1 Submit a warranty for the work of this Section for a period of three(3) years from the Date of Substantial Performance, including materials and application.
- .2 Replacement of joint sealants shall include removal of defective materials, preparation for and application of new material, and the repair and making good of damaged adjacent materials.
- .3 Defective joint sealant installation shall include, but not be restricted to, joint leakage, hardening, cracking, crumbling, melting, bubbling, shrinkage, running, sagging, change of colour, loss of adhesion, loss of cohesion, and staining of adjoining of adjacent materials or surfaces.

2 PRODUCTS

2.1 MATERIALS

- .1 All materials utilized in a sealant system shall be compatible and non-staining.
- .2 Specified proprietary products are minimum acceptable quality. Products of other manufacturers of equal or superior quality will be acceptable where specifically approved by Contractor.
- .3 Provide sealant formulation recommended by manufacturer for type of joint, substrate and service conditions applicable.

2.2 SEALANTS

- .1 Refer to Caulking Schedule for utilization of the following sealants:
 - .1 **Sealant Type 1:** Multi-component, chemical-cure polyepoxide polyurethane sealant, to ASTM C920, Type M, Grade NS, Class 25, Use T, NT, M, G, A, and O; colours as selected by the Contractor;

- .1 "DYMERIC 240" by Tremco (Canada) Ltd.
 - .2 "PRC Rubber Calk 270", by PRC Canada Inc.
 - .3 "SikaFlex 2c NS", by Sika Canada Inc.
 - .4 "Sonnenborn Sonnolastic® NP 2™", by BASF Building Materials.
 - .5 "Dynatrol® II", by Pecora Corporation.
- .2 **Sealant Type 2:** One-part, moisture-cure (fast cure) polyurethane sealant, to CAN/CGSB-19.13, Classification MC-2-25-B-N; colours as selected by the Contractor;
- .1 DYMONIC FC or Vulkem 116, by Tremco (Canada) Ltd.
 - .2 "Dynatrol® I-XL", by Pecora Corporation.
 - .3 "Sonnenborn Sonnolastic® NP 1™", by BASF Building Materials.
- .3 **Sealant Type 3:** One-part, acrylic latex sealant, to CAN/CGSB-19-GP-5M;
- .1 "TREMIFLEX® 834", by Tremco (Canada) Ltd.
 - .2 "RCS20 Acrylic Urethane", by GE Advanced Materials.
 - .3 "AC20™", by Pecora Corporation.
- .4 **Sealant Type 4:** to ASTM C920, Type S, Grade NS, Class 25, Use NT, G, A, and O, one component acetoxy silicone containing non-toxic fungicidal agents; colours as selected by the Contractor. Acceptable products are:
- .1 "Dow Corning® 786", by Dow Corning Canada Limited.
 - .2 "Sanitary SCS1700", by GE Advanced Materials.
 - .3 "Tremsil® 200", by Tremco (Canada) Ltd.
 - .4 "Sonnenborn OmniPlus™", by BASF Building Materials.
- .5 **Sealant Type 5:** One-part, medium modulus, neutral cure silicone sealant, to CAN/CGSB-19.13, Classification MCG-2-25-A-L;
- .1 SPECTREM® 2, by Tremco (Canada) Ltd.
 - .2 "Dow Corning® 795", by Dow Corning Canada Limited.
- .6 **Sealant Type 6:** One-part, non-skinning, non-hardening, synthetic rubber acoustical sealant, to CGSB 19-GP-14M;
- .1 "Tremco Acoustical Sealant", by Tremco (Canada) Ltd.
 - .2 "BC-158", by Pecora Corporation.
- .7 **Sealant Type 7:** One-part, low modulus, non-staining, neutral-cure silicone sealant, to CAN/CGSB-19.13; colour as selected by the Contractor;

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- .1 "SPECTREM® 1", by Tremco (Canada) Ltd.
 - .2 "CSL-343", by CSL Silicones Inc.

 - .8 **Sealant Type 8:** One-part, low modulus, non-staining, neutral-cure silicone sealant, to CAN/CGSB-19.13; colour as selected by the Contractor;
 - .1 "SPECTREM® 3", by Tremco (Canada) Ltd.
 - .2 "Dow Corning® 791", by Dow Corning Canada Limited.
 - .3 "Silpruf* SCS 2000", by GE Advanced Materials.
 - .4 "Sika-Sil®C 995", by Sika Canada Inc.
 - .5 "Sonnenborn Omniseal 50™", by BASF Building Materials.
 - .6 "864" by Pecora.

 - .9 **Sealant Type 9:** Multi-component, chemical curing, polyurethane sealant to ASTM C920, Type M, Grade P, Class 25, Use T, M, A, and O;
 - .1 "THC900/901", by Tremco (Canada) Ltd.
 - .2 "Sika Flex®2c NS EZ Mix TG", by Sika Canada Inc.
 - .3 "Sonnenborn Sonnolastic®", by BASF Building Materials.

 - .10 **Sealant Type 10:** Multi-component, chemical curing, self-levelling polyurethane sealant to ASTM C920, Type M, Grade P, Class 25, Use T, M, A, and O;
 - .1 "Sika Flex®2c SL", by Sika Canada Inc.
 - .2 "Sonnenborn Sonnolastic® SL 2™", by BASF Building Materials.

 - .2 Colours of sealants will be selected by the Consultant from manufacturers full available ranges of colour.
 - .1 Joints in Masonry: Colour match sealants used for control joints at masonry work; colour to match mortar joints. Sand mix be added to sealant to simulate mortar aggregate.

2.3 ACCESSORIES

- .1 Primer: Type recommended by sealant manufacturer.

- .2 Backer Rods: 30% greater diameter than joint width, with Shore-A hardness of 20, and 830-900Kpa tensile strength;
 - .1 Vertical Surfaces: extruded polyolefin rod; SofRod by Tremco Canada (div. of RPM Canada).
 - .2 Horizontal Surfaces: closed cell polyethylene rod; Standard Backer Rod by Tremco Canada (div. of RPM Canada).

- .3 Bond Breaker: pressure sensitive plastic tape, for installation where minimum specified depth of joint is unobtainable; 3M #266/#481, or Valley Industries #40.

3 EXECUTION

3.1 EXAMINATION

- .1 Before commencing joint sealing, verify at the site that joint configuration and surfaces have been provided as specified in other Sections to meet intent of sealant specification.
- .2 Verify that joint conditions will not adversely affect execution, performance or quality of completed sealed joints, and that they can be put into acceptable condition by means of preparation specified in this Section. If in doubt, verify site conditions together with manufacturer's representative of the sealant to be applied.
- .3 Verify that sealers and coatings applied to sealant substrates are compatible with the sealant used and that full bond between sealant and substrate is attained. Request samples of the sealed or coated substrate from their fabricators for testing of compatibility and bond if necessary.
- .4 Verify that specified environmental conditions are ensured before commencing joint sealing.
- .5 Defective sealed joints resulting from application to unsatisfactory joint conditions will be considered the responsibility of this Section.
- .6 Examine joint sizes for anticipated movement, and for proper width/depth ratio per manufacturer's recommendations for specified sealant.

3.2 PREPARATION

- .1 Remove loose mortar, dust, oil, grease, oxidation, mill scale, coatings and all other materials affecting bond of compounds from surfaces to which sealant compounds must adhere, except for painted surfaces, by brushing, scrubbing, scraping or grinding.
- .2 Clean down caulked metal surfaces with clean cellulose sponges or rags soaked in solvent recommended by sealant manufacturer, and wipe dry with clean cloths. Ensure that solvent is not injurious to painted surfaces.
- .3 Use methods of preparation suitable for substrate as recommended by sealant manufacturer, and that does not damage adjacent surfaces.

- .4 Ensure that releasing agents, coatings or other treatments have either not been applied to joint surfaces, or that they are entirely removed.
- .5 Where necessary to protect adjacent surfaces, mask adjacent surfaces with tape prior to priming and/or caulking.

3.3 APPLICATION

- .1 Except where specified in other Sections, seal open joints in surfaces exposed to view, and to make the building weather-tight and airtight as applicable; as indicated typically on the Drawings, and as otherwise specified and instructed by Contractor. Refer to Caulking Schedule at the end of this section.
- .2 Prime surfaces to receive sealants as required by substrate and manufacturer's specifications to ensure positive and permanent adhesion, and to prevent staining.
- .3 Pack joints tightly with backer rod set at depth specified for sealant. Fill other voids with filler.
- .4 Install joint backing material or apply bond breaker tape to achieve correct joint depth and prevent three-sided adhesion. Install bond breaker tape in bottom of joints in lieu of sealant backing where proper depth cannot be obtained when backing is installed.
- .5 Maintain depth of sealant as follows:

JOINT WIDTH	JOINT DEPTH
6mm (minimum)	6mm
6 to 13mm	depth = joint width
13 to 20mm	depth = 1/2 joint width

- .6 Maximum widths of joints are as follows:
 - .1 Exterior: 20mm.
 - .2 Interior: 10mm.
- .7 Perform joint sealing in accordance with compound manufacturer's specifications, under manufacturer's supervision, and using pressure guns and other equipment as approved by the manufacturer.
- .8 Finish joints with a full bead so that they are smooth; and free from ridges, wrinkles, air pockets and embedded foreign materials. Tool surface of joints to a slight concave profile.

- .9 Caulk joints in site-painted materials after surfaces have been prime painted.
- .10 Do not allow sealants to cover or spot surfaces outside of joints. Use masking tape protection to prevent coating of adjacent surfaces if necessary.
- .11 All work shall be performed in accordance with manufacturer's specifications for sealants specified.

3.4 CLEANING

- .1 Remove sealant smears and droppings, and masking tape immediately on completion of joint sealing.
- .2 Do not use chemicals, scrapers, or other tools, which would damage surfaces from which excess compounds, or droppings are removed. Make good materials damaged by cleaning by the installer of the damaged material and at the expense of this Section.

3.5 PRECOMPRESSED JOINT FILLERS

- .1 Install pre-compressed joint fillers in expansions joints where indicated on the drawings. Install in accordance with manufacturer's instructions.

3.6 CAULKING SCHEDULE

Sealant Type 1 or 2	<ul style="list-style-type: none"> • Interior joints between dissimilar materials. • Interior joints at perimeter of all built-in equipment. • Interior joints at perimeter of metal door and window frames.
Sealant Type 3	<ul style="list-style-type: none"> • Interior non-movement joints 6mm or less for painting (painter's caulk).
Sealant Type 4	<ul style="list-style-type: none"> • Interior joints where mildew resistance is required. • Interior joints at perimeter of all plumbing fixtures • Interior joints between counter backsplash and wall surfaces.
Sealant Type 5	<ul style="list-style-type: none"> • Glass to glass joints. • Glass to metal joints. • Metal to metal curtain wall joints.
Sealant Type 6	<ul style="list-style-type: none"> • Perimeter of all gypsum board partitions and metal screens, where sound insulation is indicated. • All vapour barrier seams and seals.
Sealant Type 7	<ul style="list-style-type: none"> • High Movement Joints (expansion).

Sealant Type 8	<ul style="list-style-type: none">• Exterior joints between dissimilar building veneer materials.• Exterior control joints in building veneers.• Exterior joints at perimeter of all door and window frames.
Sealant Type 9	<ul style="list-style-type: none">• Exterior sloped traffic joints.
Sealant Type 10	<ul style="list-style-type: none">• Exterior horizontal traffic joints.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to supply all steel (hollow metal) doors, frames, and screens.
- .2 This section shall provide all factory fabrication, hardware preparation, and accessories specified herein.

1.3 REFERENCE STANDARDS

- .1 ASTM A1008/A1008M; Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability.
- .2 ASTM A653/A653M; Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 ASTM A924/A924M; Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .4 ANSI/BHMA A156 Series; Hardware.
- .5 CSA-G40.20/G40.21; General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .6 CSA W59; Welded Steel Construction (Metal Arc Welding).
- .7 CAN4-S104; Fire Tests of Door Assemblies.
- .8 CAN4-S105; Fire Door Frames.

- .9 CAN/ULC-S102; Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .10 CAN/ULC-S702; Standard for Mineral Fibre Thermal Insulation for Buildings.
- .11 CAN/ULC-S704; Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced.
- .12 CAN/ULC-S770; Standard for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulation Foams.
- .13 Canadian Steel Door and Frame Manufacturers' Association, (CSDFMA) Canadian Manufacturing Specifications for Steel Door and Frames, 1990.
- .14 CAN/CGSB-1.181; Ready Mixed Organic Zinc-Rich Coating.
- .15 CGSB 41-GP-19Ma; Rigid Vinyl Extrusions for Windows and Doors.
- .16 NFPA-80; Fire Doors and Fire Windows.
- .17 UL Building Materials Directory.
- .18 ULC List of Equipment and Materials, Volume 2.
- .19 ITS/WH Certification Listings.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

- .1 Steel fire rated doors and frames shall be labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 and CAN4-S105 for ratings specified or indicated.
- .2 Install labelled, fire resistance rated, steel doors and frames in accordance with NFPA-80 except where specified otherwise.

1.5 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting

- .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

1.6 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 30 00.
- .2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, glazed and louvred openings, arrangement of hardware and fire ratings.
- .3 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and finishes.

2 PRODUCTS

2.1 MATERIALS

- .1 Steel Sheet: Cold-rolled, commercial grade steel sheet, Type A, to ASTM A1008/A1008M 1.519mm base metal thickness;
 - .1 Hot-dip Galvanized/Galvannealed: zinc-coated to ASTM A653/A653M, coating designation Z275, for all exterior doors and frames, and all doors and frames in Spas, Tub Rooms, Shower/Change Rooms, Kitchen, Laundry.
 - .2 Wipe-Coat Galvanized: to ASTM A653/A653M, coating designation ZF001, for all other doors and frames.
- .2 Insulation
 - .1 Polyisocyanurate: to CAN/ULC-S704, Type 1, Class 1 closed-cell polyisocyanurate foam manufactured using HCFC-free blowing agents, and as follows;
 - .1 Compressive strength: 140kPa minimum.
 - .2 Flame Spread: 500 to CAN/ULC-S102.
 - .3 Vapour Permeance: 1.5ng/Pa s m² maximum.
 - .4 Dimensional stability: 1.5% maximum linear change at 70°C and 97% relative humidity for 7 days.
 - .5 Curing Time: minimum 24 hours, plus 24 hours per 25mm of thickness before shipment from manufacturer.
 - .6 Long Term Thermal Resistance (LTTR)
 - .1 RSI 1.04 for 25mm board thickness.

- .2 RSI 2.09 for 50mm board thickness.
- .3 RSI 3.18 for 75mm board thickness.

- .2 Semi-Rigid Mineral Fibre: processed from rock, slag, or glass, to CAN/ULC-S702 Type 1, minimum density 24 kg/m³;
- .3 Primer: Zinc-rich rust inhibitive type to CAN/CGSB-1.181.

2.2 ACCESSORIES

- .1 Door Bumpers: Single stud rubber/neoprene type.
- .2 Exterior Top Caps: Rigid PVC extrusion conforming to CGSB 41-GP-19Ma.
- .3 Frame Thermal Breaks: Rigid PVC extrusion conforming to CGSB 41-GP-19Ma.

2.3 FABRICATION

- .1 General
 - .1 Fabricate doors and frames as detailed, to CSDFMA Specifications for Commercial Steel Doors and Frames, except where specified otherwise.
 - .2 Blank, reinforce, drill and tap doors and frames for all hardware. Mortised cutouts shall be protected with steel guard boxes.
 - .3 Reinforce doors and frames for surface mounted hardware.
 - .4 Formed edges shall be true and straight with a minimum radius for the thickness of steel used.
 - .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.
 - .6 For rebate opening heights up to and including 1525mm, provide two anchors, and an additional anchor for each additional 760mm or fraction thereof.
 - .7 Frames in existing concrete, masonry or steel shall be provided with anchors located not more than 152mm from top and bottom of each jamb, and intermediate anchors at 660mm o.c. max.

- .8 All screw anchors for frames shall be Robertson flat head type and fully countersunk.
- .9 Each door opening shall be prepared for rubber stud door silencers, three (3) for single doors, two (2) for double doors.
- .10 Factory-apply touch up primer to galvanized steel doors and frames where coating has been removed during fabrication.
- .11 Fire labelled doors and frames shall be provided for those openings requiring fire protection ratings. Doors and frames shall be tested in accordance with CAN4-S104.
- .12 Provide all required internal steel frame reinforcement to ensure structural rigidity and integrity, including connections to nearest building structure elements.
- .13 Door faces of all steel doors shall be fabricated without visible seams, free of scale, pitting, coil brakes, buckles and waves.
- .14 Construct stile and rail doors in same manner as flush doors.
- .15 Construct matching transom panels or inactive leaves in same manner as doors.
- .16 Longitudinal edges of interior doors shall be mechanically interlocked, adhesive assisted with edge seams tack welded, filled and sanded flush with no visible seam.
- .17 Lock and hinge edges shall be beveled 3mm in 50mm unless hardware or door swing dictates otherwise.
- .18 Top and bottom of doors shall be provided with inverted, recessed, 1.519mm steel end channels, welded to each face sheet at 152mm on center maximum.
- .19 Exterior doors shall be provided with factory installed flush PVC top caps. Fire labeled exterior doors shall be provided with factory-installed flush steel top caps.
- .20 Provide 1.519mm closer reinforcement channels at top of all doors (interior and exterior).

- .21 Fire labelled doors shall be provided for those openings requiring fire protection ratings, as indicated. Such frames shall be tested in conformance with CAN4-S104.

- .2 Doors
 - .1 Exterior Doors
 - .1 Face Sheets: 1.519mm base metal thickness.

 - .2 Door Cores
 - .1 Bonded (Insulated) Core: Polyisocyanurate insulation as specified above, in slab form, thermally bonded to door skins.

 - .2 Interior Doors
 - .1 Face Sheets: 1.214mm base metal thickness.

 - .2 Door Cores
 - .1 Steel Stiffened: vertically stiffened with 0.912mm steel ribs at 152mm o.c. maximum, with all voids filled completely with semi-rigid mineral fibre insulation as specified above.

 - .2 Temperature Rise Rated (TRR): Core composition to limit temperature rise on the unexposed side of door to 121°C, 232°C, or 343°C temperature rise at 30 minutes, or 250°C at either 30 or 60 minutes, as determined by Ontario Building Code requirements. Core shall be tested as part of a complete door assembly, in accordance with CAN4-S104.

 - .3 Use Steel Stiffened for all fire rated doors, and heavy use doors, where temperature rise rating is not required.

 - .4 Use Temperature Rise Rated for doors indicated in schedules.

 - .5 Use Steel Stiffened core for all others.

 - .3 Hardware Preparation
 - .1 Doors shall be factory blanked, reinforced, drilled and tapped for fully templated mortised hardware only, in accordance with the final approved schedule and templates provided by the hardware supplier.

- .2 Doors shall be factory blanked and reinforced only for mortised hardware that is not fully templated.
- .3 Doors shall be factory reinforced only for surface mounted hardware.
- .4 Templated holes 13mm diameter and larger shall be factory prepared, except mounting and through bolt holes, which shall be by the contractor responsible for installation on site, at the time of application. Templated holes less than 13mm diameter shall be factory prepared only when required for the function of the device (for knobs, levers, cylinders, thumb or turn pieces) or when these holes over-lap function holes.
- .5 Drilling and tapping for surface mounted hardware or mortised hardware that is not fully templated shall be by the contractor responsible for installation on site, at the time of application.
- .6 Hinge and pivot reinforcements shall be 3.416 mm steel minimum high frequency type reinforcing.
- .7 Doors in excess of 2450mm rabbet height shall be prepared for 114.3mm heavy weight 4.6mm hinges minimum.
- .8 Lock, strike and flush bolt reinforcements shall be 1.519mm steel minimum.
- .9 Reinforcements for concealed closers and holders shall be 2.657mm steel minimum.
- .10 For surface mounted hardware, reinforcements shall be 1.519mm steel minimum.
- .11 Where electrically or electronically operated hardware is specified on the schedules or details or the final approved schedule and templates provided by the hardware supplier, hardware enclosures and/or junction boxes, where indicated on the templates, shall be provided and inter-connected with CSA-approved 13mm diameter conduit and connectors.

- .4 Glazing
 - .1 Make provision for glazing as indicated and provide necessary glazing stops in accordance with tested and labelled assemblies.
 - .2 All glazing rebates and stops for frames located in fire separations shall be minimum 20mm in height.
 - .3 Where glazing materials up to and including 8mm thick are specified, doors shall be provided with 0.912mm steel glazing trim and snap-in glazing stops.
 - .4 Where glazing materials greater than 8mm thick are specified, doors shall receive 0.912mm steel trim and screw-fixed glazing stops. Screws shall be #6 x 31mm flat head, countersunk self-drilling type at 300mm on center maximum.
 - .5 Glazing trim and stops shall be accurately fitted, butted at corners, with removable glazing stops located on the 'push' side of the door.
- .5 Louvers
 - .1 Where specified on the schedules or details, doors shall be prepared for door louver inserts.
- .6 Finishing
 - .1 Remove weld slag and splatter from exposed surfaces.
 - .2 All tool marks, abrasions and surface blemishes shall be filled and sanded to present smooth uniform surfaces.
 - .3 On exposed surfaces where zinc coating has been removed during fabrication, doors shall receive a factory applied touch-up primer.
 - .4 Primer shall be fully cured prior to shipment.
- .3 Frames
 - .1 General
 - .1 Fabricate frames from tension leveled steel to ASTM A924, galvanized to ASTM A653/653M, Commercial Steel (CS), Type B.

- .2 Exterior Frames
 - .1 Fabricate from 1.519mm base metal thickness.
 - .2 Exterior frame product shall be supplied set-up and welded.
 - .3 Thermally Broken Frames
 - .1 Fabricate thermally broken frames for exterior doors using 1.2mm steel, separating exterior portion of frame from interior portion with polyvinylchloride thermal breaks.
 - .2 Thermally broken sections shall not be assembled by means of screws, grommets or other fasteners.
 - .3 Where thermally broken welded frame product is specified, welds shall not cause thermal transfers between interior and exterior surfaces of the frame sections.
 - .4 Closed sections (mullions and center rails) of thermally broken frames shall be factory insulated with semi-rigid mineral fibre insulation as specified above.
 - .5 Insulation of open sections (jambs, heads and sills) shall be provided on site.
- .3 Interior Frames
 - .1 Fabricate from 1.519mm base metal thickness.
 - .2 Interior frame product shall be supplied set-up and welded.
- .4 Corner joints shall be accurately mitered and tightly fitted with integral door stops mitered or butted when assembled.
- .5 Corner joints shall be welded on the inside of the profiles' returns and faces for set-up and welded frames.
- .6 Joints at mullions, transom bars, sills or center rails shall be coped accurately, butted and tightly fitted, with faces securely welded, matching corner joint faces.
- .7 Frame product shall be fabricated with integral door stops having a minimum height of 16mm.
- .8 Glazing stops shall be square, formed 0.912mm steel, 16mm minimum bevelled height channel, accurately fitted, butted at corners and fastened to frame sections with #6 x 31mm flat head countersunk scrulox (self-drilling) type screws at 300mm on center maximum. Stops shall be 20mm high at all labelled frames.

- .9 Locate glazing stops on room side of screens, not corridor side.
- .10 Where required due to site access, as indicated on schedules, when advised by the contractor responsible for co-ordination or installation, or when shipping limitations so dictate, frame product shall be fabricated in sections for splicing in the field.
- .11 Field spliced jambs, heads and sills shall be provided with 1.519mm steel splice plates securely welded into one section, extending 100mm minimum each side of splice joint.
- .12 Field splices at closed sections (mullions or center rails) shall be 1.519mm steel splice angles securely welded to the abutting member. Face of splice angle shall extend 100mm minimum into closed sections when assembled.
- .13 Field splice joints shall be welded, filled and ground to present a smooth uniform surface.
- .14 On factory-assembled frame product, each door opening shall be provided with two (2) temporary steel jamb spreaders welded to the base of the jambs or mullions to maintain proper alignment during shipping and handling. Spreaders shall be removed prior to anchoring of frame to floor.
- .15 Each door opening shall be prepared for single stud door silencers, three (3) for single door openings, two (2) for double door openings. Silencers shall be shipped loose for installation after finish painting.
- .16 Hardware Preparation
 - .1 Frame product shall be blanked, reinforced, drilled and tapped for fully templated mortised hardware only, in accordance with the final approved schedule and templates provided by the hardware supplier.
 - .2 Frame product shall be factory blanked and reinforced only for mortised hardware that is not fully templated.
 - .3 Frame product shall be reinforced only for surface mounted hardware.

- .4 Drilling and tapping for surface mounted hardware or mortised hardware not templated shall be done at the time of installation.
- .5 Frames shall be prepared for 114mm standard weight hinges (minimum).
- .6 Hinge and pivot reinforcements shall be 3.416mm steel minimum reinforcing, high frequency type shall be provided.
- .7 Strike reinforcements shall be 1.519mm steel minimum.
- .8 Reinforcements for surface mounted hardware, concealed closers and holders and flush bolts shall be 2.657mm steel minimum.
- .9 Mortised cutouts shall be protected with 0.759mm steel minimum guard boxes.
- .10 Where electrically or electronically operated hardware is specified on schedules or details, or the final approved schedule and templates provided by the hardware supplier, hardware enclosures and/or junction boxes where indicated on templates shall be provided and inter-connected with CSA-approved 13mm diameter conduit and connectors.
- .17 Anchorage
 - .1 Frame product shall be provided with anchorage appropriate to floor, wall and frame construction.
 - .2 Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite on the strike jamb, except as indicated below.
 - .3 Frame product installed in unit masonry partitions shall be provided with 4.0mm diameter steel wire anchors, 1.214mm steel adjustable stirrup and strap or "T" type anchors as conditions dictate.

- .4 Where frame product is installed prior to construction of the adjacent wall, each jamb shall be provided with 1.519mm steel floor anchors. Each anchor shall be provided with two (2) holes for mounting to the floor and shall be securely welded to the inside of the jamb profile designed so as not to permit thermal transfers from exterior to interior surfaces of the frame sections.
- .5 All visible frame anchor screws shall be Robertson flat head countersunk type.
- .6 Frame product installed in steel stud and drywall partitions shall be provided with 0.912mm steel snap-in or "Z" type stud type anchors.
- .7 Jambs of frames in previously placed concrete, masonry or structural steel shall be punched and dimpled to accept machine bolt anchors, 6.4mm diameter, located not more than 152mm from the top and bottom of each jamb. Anchor preparations and guides shall also be located immediately above or below the intermediate hinge reinforcing and directly opposite on the strike jamb. Each preparation shall be provided with 1.519mm anchor bolt guides.
- .8 After sufficient tightening of the anchor bolt, the head shall be welded so as to provide a non-removable application. Welded bolt and dimple shall be filled and ground to present a smooth uniform surface, prior to finish painting.
- .9 Where indicated on schedules or details, channel extensions shall be provided from the top of the frame assembly to the underside of the structure above. Extensions shall be fabricated from 2.657mm steel formed channels, mounting angles and adjusting brackets, with mounting angles welded to the inside of frame head. Formed channels, adjusting brackets and fasteners shall be shipped loose. Channels shall be mechanically connected to mounting angles and adjusting brackets with supplied fasteners on site.

.10 For fire labeled frames, each strike jamb shall be provided with an additional snap-in anchor in each face, to be installed above or below the strike reinforcement. Each head for fire labeled pairs shall be provided with two (2) snap-in anchors, to be installed in the head faces at the center of the rabbet opening width.

.18 Finishing

.1 Remove weld slag and spatter from exposed surfaces.

.2 All tool marks, abrasions and surface blemishes shall be filled and sanded to present smooth and uniform surfaces.

.3 On exposed surfaces where zinc has been removed during fabrication, frame product shall receive a factory applied touch-up primer.

2.4 SIZES AND TOLERANCES

.1 Widths of door openings shall be measured from inside of frame jamb rabbet with a tolerance of +1.6mm - 0.8mm.

.2 Heights of door openings shall be measured from the finished floor (exclusive of floor coverings) to the head rabbet of the frame with a tolerance of $\pm 1.2\text{mm}$.

.3 Unless builders' hardware dictates otherwise, doors shall be sized so as to fit the above openings and allow a 3mm clearance at jambs and head. A clearance of 19mm between the bottom of the door and the finished floor (exclusive of floor coverings) shall be provided. Tolerances on door sizes shall be $\pm 1.2\text{mm}$.

.4 Manufacturing tolerances on formed frame profiles shall be $\pm 0.8\text{mm}$ for faces, door stop heights and jamb depths. Tolerances for throat openings and door rabbets shall be $\pm 1.6\text{mm}$ and $\pm 0.4\text{mm}$ respectively. Hardware cutout dimensions shall be as per template dimensions, +0.4mm, - 0.

2.5 HARDWARE LOCATIONS

.1 Hardware preparations in frame product shall be as noted below and locations on doors shall be adjusted for clearances specified above.

- .2 Top of upper hinge preparation for 114.3mm hinges shall be located 180mm down from head, transom mullion or panel as appropriate. The top of the bottom hinge preparation for 114.3mm hinges shall be located 310mm from finished floor as defined above. Intermediate hinge preparations shall be spaced equally between top and bottom cutouts. For dutch door frames, top and bottom hinge locations shall be as above, with the tops of intermediate hinges located at 930mm and 1403mm from finished floor.
- .3 Strike preparations for unit, integral, cylindrical and mortise locks and roller latches shall be centered 1033mm from finished floor. Strikes for deadlocks shall be centered at 1220mm from finished floor. Strikes for panic or fire exit hardware shall be located as per device manufacturer's templates.
- .4 Push and/or pulls on doors shall be centered 1070mm from finished floor.
- .5 Preparations not noted above shall be as per hardware manufacturer's templates.
- .6 Hardware preparation tolerances shall comply with ANSI A156 Series standards.

3 EXECUTION

3.1 INSTALLATION

- .1 General
 - .1 Install all doors and frames in accordance with NFPA-80.
- .2 Doors
 - .1 Install doors in accordance with manufacturer's instructions and templates.
 - .2 Install hardware in accordance with hardware templates, manufacturer's instructions and Section 08 71 00.
 - .3 Provide maximum clearances at edges of doors as follows:
 - .1 Between door and frame at head and jambs: 3mm.
 - .2 At meeting edges pairs of doors and at mullions: 3mm.
 - .3 At transom panels, without transom bars: 3mm.
 - .4 At sills without thresholds: 16mm maximum above finish floor.
 - .5 At sills with thresholds: 3mm above threshold.

- .4 Adjust operable parts for correct function.
- .5 Install louvres securely in doors.
- .3 Frames
 - .1 Set frames plumb, square, level and at correct elevation.
 - .2 Secure anchorages and connections to adjacent construction.
 - .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1220mm wide. Remove temporary spreaders after frames are built-in.
 - .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
 - .5 Install all frame reinforcing where indicated or required for structural rigidity.
- 3.2 FINISH REPAIRS
 - .1 Touch up with primer galvanized finish damaged during installation.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide all aluminum doors, frames, sidelites, transoms, and screens as designed, including the following:
 - .1 All required frame reinforcing,
 - .2 All internal sealants,
 - .3 All factory preparation and installation of hardware.
- .2 Work of this section also includes the relocation of existing doors and frames to new locations, and modifications to existing screens, as indicated on the drawings.

1.3 REFERENCE STANDARDS

- .1 Aluminum Association (AA); DAF-45, Designation System for Aluminum Finishes.
- .2 American Architectural Manufacturers Association (AAMA); Aluminum Curtain Wall Design Guide Manual.
- .3 ASTM A653/A653M; Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .4 ASTM B209; Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .5 ASTM B221M; Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

- .6 ASTM E283; Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, Doors.
- .7 ASTM E330; Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- .8 ASTM E331; Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- .9 ASTM E1105; Test Method for Field Determination of Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference.
- .10 CSA-G40.21; Structural Quality Steels
- .11 CAN/CSA G164; Hot Dip Galvanizing of Irregularly Shaped Articles.
- .12 CAN3-S157; Strength Design in Aluminum.
- .13 CSA W59.2; Welded Aluminum Construction.
- .14 CAN/ULC-S702; Standard for Mineral Fibre Thermal Insulation for Buildings.
- .15 CAN/ULC-S114; Determination of Non-combustibility of Building Materials.

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Subcontractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

1.5 PERFORMANCE REQUIREMENTS

- .1 Structural performance shall be based on CAN3-S157, Strength Design in Aluminum, and a maximum deflection of 1/175 of the span.
- .2 Air infiltration shall be tested in accordance with ASTM E283 at a pressure differential of 75Pa. A single 914x2134 door and frame shall not exceed 2.78m³/h m per linear metre of crack. A pair of doors and frame shall not exceed 5.56m³/h m per linear metre of crack.
- .3 Design and size components to withstand dead and live loads caused by pressure and suction of wind, acting normal to plane of system, as calculated in accordance with the Ontario Building Code.
- .4 Size glass units and glass dimensions to limits established in CAN/CGSB-12.20.
- .5 System to provide for expansion and contraction within system components caused by a cycling temperature range of 95°C over a 12 hour period without causing detrimental affect to system components.
- .6 Drain water entering joints, condensation occurring in glazing channels or migrating moisture occurring within system, to the exterior by a weep drainage network.
- .7 Maintain continuous air barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass.

1.6 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 30 00.
 - .2 Indicate materials and large scale details for profiles of components, elevations of unit, anchorage details, required reinforcing, location of isolation coating, description of related components, finishes and fasteners.
- .2 Product Data
 - .1 Submit product data for the following, in accordance with Section 01 30 00:
 - .1 Material composition
 - .2 Finishes
 - .3 Hardware requirements
- .3 Test Reports
 - .1 Submit test report from approved independent testing laboratory, certifying windows comply to performance requirements of CAN/CSA-A440.2, and this specification.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Provide products and systems from one single source manufacturer. Mixing of doors, frames, and hardware from different manufacturers is not acceptable. Doors shall be from same manufacturer as aluminum curtain wall.

2.2 MATERIALS

- .1 Aluminum Members: Alcan 6063-T54 alloy and temper.
- .2 Extruded Aluminum: to ASTM B221.
- .3 Sheet Aluminum: ASTM B209.
- .4 Screws, bolts and fasteners: 300 series stainless steel or 400 series stainless steel cadmium plated.
- .5 Sheet Steel: Zinc-iron Alloy (ZF) coated steel sheet to ASTM A653/A653M structural quality Grade A, with Z275 coating, for interior surfaces not exposed to weather, unpainted finish, minimum 0.914mm base steel thickness.
- .6 Steel Reinforcement: to CAN/CSA-G40.21, grade 300W, as required by system design limitations.
- .7 Glass: refer to Section 08 80 00.
- .8 Glazing gaskets: extruded, black, closed cell or dense elastomer of durometer appropriate to the function. Provide Grey gaskets at interior aluminum doors and frames (screens). Provide standard Black for exterior.
- .9 Sealants: refer to Section 07 92 00.
- .10 Isolation Coating: alkali resistant, epoxy resin solution.
- .11 Thermal separators for door cladding shall be rigid PVC extrusions.
- .12 Weatherstrip: Mohair or Elastomeric.
- .13 Door Bumpers: neoprene.
- .14 Perimeter Foam Sealant: single component polymeric low-expansion insulating sealant;
 - .1 Great Stuff PRO™, by Dow Chemical Company.

.2 CF812, by Hilti Corporation.

2.3 ENTRANCE DOORS AND FRAMES

.1 Exterior Frames: nominal 51mm x 114mm, extruded aluminum, thermally broken for double glazing; center glazed.

.1 Acceptable products are:

.1 TRIFAB™ VG 451T, by Kawneer Company Canada Ltd.

.2 BF3400 Series, by Alumicor Limited.

.3 Series FG-3000, by Oldcastle.

.4 2500 Series by Commdoor Aluminum.

.2 Interior Vestibule Frames: nominal 45mm x 114mm, extruded aluminum, for single glazing; center glazed (no sloped stops).

.1 Acceptable products are:

.1 TRIFAB™ VG 450, by Kawneer Company Canada Ltd.

.2 TL1800 Series, by Alumicor Limited.

.3 Series FG-1000, by Oldcastle.

.4 1450 Series by Commdoor Aluminum.

.3 Exterior Doors: medium stile, extruded aluminum, thermally broken for double glazing; with the following options;

.1 Bottom Rails: manufacturer's standard height.

.2 Provide Door Adapters for exterior curtain wall system where detailed.

.3 Acceptable Products

.1 Insulclad 360, by Kawneer Company Canada Ltd.

.2 Series 400A Insuldoor, by Alumicor Limited.

.3 Model MS375T, by Oldcastle.

.4 4300 Series by Commdoor Aluminum.

.4 Interior Vestibule Doors: medium stile, extruded aluminum for single glazing, with the following options;

.1 Bottom Rails: manufacturer's standard height.

.2 Acceptable Products

.1 Series 350, by Kawneer Company Canada Ltd.

.2 Canadiana Series 400A, by Alumicor Limited.

.3 Model MS375, by Oldcastle.

.4 360 Series by Commdoor Aluminum.

2.4 HARDWARE

.1 Weather Stripping: Mohair or Elastomeric.

.1 Provide standard Black gasketing for all exterior doors and screens.

.2 Hinges: butt hinges; commercial quality stainless steel hinges; five-knuckle construction with two sets of stainless steel ball bearings and pin. (minimum 3 per leaf).

.3 Mortise Lock: Adams Rite MS-1850A Deadlock (cylinders supplied under Section 08 71 00).

- .4 Flush Bolts: fully recessed, die cast zinc/nylon bolts; finish to match doors.
 - .5 Closers: LCN 4040 Super Smoothee, surface-mounted closers, door mounted, finish to match doors.
 - .6 Exit Devices: Dor-O-Matic 1790 Rim Panic Device, finish to match doors.
 - .7 Electric Strikes: Adams Rite 7100, 24V electric strikes (electrical connection by Division 26).
 - .8 Push/Pulls: supplied and installed under Section 08 71 00.
 - .9 Power Door Operators: supplied and installed under Section 08 71 00.
 - .10 Additional hardware supplied under Section 08 71 00 for aluminum doors shall be prepared for, and installed by this Section.
- 2.5 FINISH
- .1 Anodized: Class 1 anodic colour coating to AA-M12C22A42/44; #29 Black.
- 2.6 FABRICATION
- .1 Fabricate doors and frames from extrusions of size and configurations shown on drawings.
 - .2 Door rails and stiles shall be porthole extrusions. Corner construction shall be mechanical clip, and plug and fillet weld fastening.
 - .3 Fabricate units square and true with maximum tolerance of plus or minus 1.5mm for units with a diagonal measurement of 1800mm or less and plus or minus 3mm for units with a diagonal measurement over 1800mm.
 - .4 Face dimensions detailed are maximum permissible sizes.
 - .5 Brace frames to maintain squareness and rigidity during shipment and installation.
 - .6 Provide all internal reinforcing as required for the proper structural design and support of the framing system.
 - .7 All joints shall be accurately machined, assembled and sealed to provide neat weathertight joints.

3 EXECUTION

3.1 INSTALLATION

- .1 Erect and anchor all frames square and level using concealed fastenings where possible.
- .2 Anchors to be built into the structure shall be provided to the General Construction Manager for setting in accordance with the approved shop drawings.
- .3 Doors shall be installed, glazed and adjusted by experienced personnel in accordance with the manufacturer's instructions and reviewed shop drawings.
- .4 All items in this Section shall be set in their correct location and shall be set level, square, plumb and at proper elevations and in alignment with other work.
- .5 Manufacturer's nameplates or labels shall not be installed on the exterior of doors or screens.

3.2 ISOLATION COATING

- .1 Isolate aluminum from following components, by means of isolation coating:
 - .1 Dissimilar metals except stainless steel, zinc, or white bronze.
 - .2 Concrete, masonry, and masonry mortar.
 - .3 Untreated wood.

3.3 CAULKING

- .1 Apply sealant in accordance with Section 07 92 00.

3.4 CLEANING

- .1 During installation, remove all corrosive or foreign materials or droppings resulting from work of this or other trades.
- .2 Clean all surfaces in accordance with manufacturer's instructions for final cleaning of finished surfaces.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide all wood doors, including:
 - .1 Factory fabrication.
 - .2 Factory prep for finish hardware.
 - .3 Factory prime coat for field finishing.
 - .4 Factory finishing.
 - .5 Shipment to the site.

1.3 REFERENCE STANDARDS

- .1 AWI / AWMAC Quality Standards for Architectural Woodwork.
- .2 CAN3-A172; High Pressure, Paper Base, Decorative Laminates.
- .3 CAN4-S104; Fire Tests of Door Assemblies.
- .4 CAN4-S105; Fire Door Frames.
- .5 CAN/CSA-O132.2 SERIES; CSA Standards for Wood Flush Doors.
- .6 CAN/CSA-O132.5; Stile and Rail Wood Doors.
- .7 CSA-O115; Hardwood and Decorative Plywood.
- .8 CSA O112.6/O112.7; Resorcinol Resin Adhesive.
- .9 CAN/CGSB-71.19; Adhesive, Contact, Sprayable.
- .10 CAN/CGSB-71.20; Adhesive, Contact, Brushable.
- .11 CAN/CGSB-11.3; Hardboard.
- .12 NFPA 80 – Fire Doors and Windows; National Fire Protection Association

- .13 WDMA IS 1A; Wood Door Manufacturers Association Installation Standard.

1.4 SUBMITTALS

.1 Product Data

- .1 Manufacturer's specifications and technical data including the following :
 - .1 Detailed specification of construction and fabrication.
 - .2 Facing, core design and material, glue type, rails, and blocking for screwattached hardware.
 - .3 Details of construction, light and louver opening details, and glazing thickness.
 - .4 Indicate blocking for hardware attachment as applicable to each door type.
 - .5 Indicate lead thickness for lead lined doors.
- .2 Manufacturer's installation instructions.
- .3 Manufacturer's finishing instructions for field finished doors.
- .4 Manufacturer's recommendations for care and maintenance of doors.

.2 Shop Drawings: Provide the following information:

- .1 Door type,
- .2 Door size,
- .3 Fire Rating,
- .4 Hardware types and locations,
- .5 Hardware blocking requirements and location,
- .6 Glazing stop details,
- .7 Vision panel or louver cutout size and location, and
- .8 Factory finish system/approved colour(s).

.3 Samples:

- .1 Colour Samples Of Factory Finishing: submit samples not less than 102x152mm size labeled with sample production date, of representative finish indicating range of colour and variation that can be expected.
- .2 Construction Samples. Corner sections with door faces, edges, and core representative of the specified door type(s). Corner samples to be not less than 152x228mm.

1.5 QUALITY ASSURANCE

.1 Material Qualifications

-
- .1 Comply with requirements of AWMAC/AWI Quality Standards for material, fabrication, finishing, and installation except where otherwise indicated.
 - .2 Supply doors from one manufacturer for entire project.
 - .2 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .3 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .4 Documentation
 - .1 If requested, submit documentation to support the competency of firms and personnel.
 - .5 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- .1 Store and protect doors in accordance with manufacturer's recommendations.
 - .2 Store doors flat and off the floor on a level surface in a dry, well-ventilated building. Do not store on edge. Protect doors from dirt, water and abuse.
 - .3 Certain wood species are light sensitive. Protect doors from exposure to light (artificial or natural) after delivery.

- .4 Do not subject interior doors to extremes in either heat or humidity. HVAC systems should be operational and balanced, providing a temperature range of 10-32°C and 30% to 50% relative humidity.
- .5 When handling doors, always lift and carry. Do not drag across other doors or surfaces. Handle all doors (finished or unfinished) with clean hands or gloves.

1.7 EXTENDED WARRANTY

- .1 Provide a Warranty certificate from the door manufacturer which binds the manufacturer to replace all doors found to have defects in factory workmanship or materials, or which warp more than 6mm out of plane, under normal use, for a minimum of five (5) years from the Date of Substantial Performance. Replacement doors shall bear same warranty from date of replacement.
- .2 "Replace" as used herein, does not include hanging, installation or field finishing. This work shall be performed by the Contractor for the warranty period stipulated in the General Conditions of the Contract. If doors were originally supplied factory finished, manufacturer must supply replacement doors with same finish.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 Lambton Doors, Lambton PQ (distr. by Stegweit & Company Inc., Oakville ON).
- .2 Door-Lam Manufacturing of Ottawa, Canada.
- .3 Les Portes Baillergeon (Masonite), St.-Ephrem, Beauce, PQ.

2.2 FLUSH DOORS

- .1 Grade: Premium (Architectural).
- .2 Cores
 - .1 Solid Particleboard Core: to CAN/CSA-O132.2; 5 ply bonded and sanded core construction with no voids; minimum 115mm wide hardwood stile and rail frame bonded to particleboard core and veneer crossbands; solid or engineered wood closer blocks, lock blocks, panic hardware blocks, and face veneer matchedstiles.
 - .1 Fire Rating: 20 minutes.
- .3 Face Panels
 - .1 **Paint Grade Veneer: Natural Birch.**

- .4 Adhesives
 - .1 Hot press Type I - Waterproof.

- .5 Vision Frames
 - .1 Interior - Non-Fire Rated
 - .1 Wood species to match door veneer with square glazing stops and mitred corners.

2.3 FABRICATION

- .1 Fabricate fire-rated doors in compliance with the requirements of the testing authority providing the fire label.

- .2 Laminate 5-ply door facing, cross banding, and assembled core in a hot press.

- .3 Fit decorative laminate or wood veneer door edges to door stiles and rails prior to application of face veneers.

- .4 Reinforcing
 - .1 Top Rail: 127mm wide Solid Lumber or LSL.
 - .2 Bottom Rail: 127mm wide Solid Lumber or LSL.
 - .3 Through-bolting of hardware or accessories is not permitted.

- .5 Non Rated Pairs of Doors: Fabricate meeting edge type between pairs of non-fire rated doors with no bevel.

- .6 Factory-prefit and bevel doors (3°) to suit frame sizes indicated, with 4.76mm prefit in width, +0mm/ -0.79mm, tolerances. Prefit top of door 3mm +1.6mm/ -0mm, and undercut as designated by floor condition. For fire-rated doors comply with NFPA-80 for prefits and undercuts.

- .7 Factory pre-machine doors for hardware that is not surface applied. Locations and hole patterns to comply with specified hardware requirements as per NFPA-80 standards for doors specified; and to maintain door manufacturer's warranty.

- .8 Specific locations for hardware will be coordinated between frame and door manufacturers.

- .9 Hardware preparations as per hardware schedule(s) provided by Section 08 71 00. Hardware preparations to be neatly and cleanly squared as required per hardware templates.

- .10 Factory Preparation for Light Openings and Louvers: Cut and trim openings through doors to comply with NFPA-80 requirements where indicated; and to maintain door manufacturer's warranty.
- .11 Prepare doors for louvres, opening frames and glass and where specified, provide matching hardwood glazing stops with mitred corners.

2.4 FACTORY FINISHING

- .1 Finish Types
 - .1 Factory Priming: solid colour priming coat to AWI Section 1500, manufacturer's standard, for doors to be field painted.
 - .2 Apply one coat of uncut shellac to all cutouts on doors.

3 EXECUTION

3.1 EXAMINATION

- .1 Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
- .2 Verify door frames are of type required and are installed as required for proper installation of doors.
- .3 Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- .1 Comply with door manufacturer's recommendations, AWI Quality Standards, and WDMA IS-1.
- .2 Install doors using hardware, including fasteners, and in strict conformance with hardware manufacturer's instructions as specified under Section 08 71 00.
- .3 Install fire rated doors and transoms in compliance with requirements of labeling agency, and NFPA No. 80.
- .4 Coordinate installation of doors with installation of hollow metal frames specified under Section 08 11 13, and prefabricated screens specified under Section 10 22 00.
- .5 Coordinate installation of glass and glazing specified under Section 08 80 00.

- .6 Install non-fire rated wood transoms using concealed hardware (Stanley #1697 Spring Bolts), minimum 2 bolts per jamb.
- .7 Field Trimming
 - .1 Trim door height by cutting bottom edge to not more than 19mm. Trim fire-rated door height at bottom edge only, in compliance with fire-rating requirements.
 - .2 Trim non-rated door width by cutting equally between both jamb edges.
 - .3 Pilot drill screw and bolt holes.
- 3.3 TOLERANCES
 - .1 Maximum Diagonal Distortion: 6mm measured with straight edge or taut string, corner to corner, over not more than 1066 x 2134mm surface area.
 - .2 Maximum Vertical Distortion: 6mm measured with straight edge or taut string, top to bottom, over not more than 1066 x 2134mm surface area.
 - .3 Maximum Width Distortion: 6mm measured with straight edge or taut string, edge to edge, over not more than 1066 x 2134mm surface area.
- 3.4 FIELD QUALITY CONTROL
 - .1 Manufacturer's Field Services
 - .1 Manufacturer's representative to visit the site at the beginning of installation and at completion of installation. Review initial installation and provide written comments as necessary.
- 3.5 ADJUSTING
 - .1 Remove and rehang doors, which do not swing or operate freely. If door cannot be made to operate properly, remove and install new door.
 - .2 Remove doors damaged during installation and install new doors.
 - .3 Touch-up
 - .1 If field fitting of prefinished doors is required, refinish affected surfaces to match original factory finish as directed by the door manufacturer.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide wall and ceiling mounted access doors.

1.3 SUBMITTALS

- .1 Provide manufacturer's data and independent test reports/approvals for all fire-rated access doors.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver all products to the site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- .2 Store products indoors in a clean, dry area, having environmental conditions acceptable to product manufacturer.
- .3 Protect products from damage during storage and installation.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Acudor Products Inc., Pickering ON.
- .2 APS Access Panel Solutions Inc., Victoria BC.
- .3 Nystrom Building Products Inc., Brooklyn Park MN.
- .4 Williams Brothers Corporation of America, Front Royal VA.

2.2 MATERIALS

- .1 Steel for Doors and Frames: 16 gauge, wipe-coat galvanized, commercial grade sheet steel.
- .2 Screws: Zinc plated.
- .3 Springs: Stainless steel.
- .4 Gasket: Rubber.
- .5 Door Inlay:
 - .1 For Ceramic Tile Finish: Reinforced Cement Board to ANSI A118.9. Thickness shall be the same as on the wall or ceiling in which the access door is to be installed.

2.3 ACCESS DOOR TYPES

- .1 Non-fire Rated for Ceramic Tile Finish: recessed access door, for flush installation in gypsum board surfaces where required to provide for ceramic tile finish. Door panel recessed to receive inlay and ceramic tile. Door flange shall be fabricated as a recessed (concealed) flange; sizes as indicated;
 - .1 AT-5020, by Acudor Products Inc.
 - .2 RA Series, by Nystrom Building Products Inc.
 - .3 WB-RDW, by Williams Brothers Corporation of America
- .2 Non-fire Rated for Paint Finish in Concrete Block: Flush access door, for use in concrete block surfaces where required to provide access; sizes as indicated;
 - .1 UF-5000, by Acudor Products Inc.
 - .2 NT Series, by Nystrom Building Products Inc.
 - .3 WB-SMP, by Williams Brothers Corporation of America
- .3 Fire Rated for Concrete Block/Paint Finish: Flush access door, for use in concrete block surfaces where required to provide fire rated access; sizes and fire ratings as indicated;
 - .1 FB-5060, by Acudor Products Inc.
 - .2 IT Series, by Nystrom Building Products Inc.
 - .3 WB-FR, by Williams Brothers Corporation of America
- .4 Fire Rated & Non-fire Rated for Gypsum Board/Paint Finish: Flush access door, for use in gypsum board surfaces where required to provide fire rated access; sizes and fire ratings as indicated;
 - .1 FB-5060-DW, by Acudor Products Inc.
 - .2 UW Series, by Nystrom Building Products Inc.
 - .3 WB-FR/DW, by Williams Brothers Corporation of America

2.4 FABRICATION

- .1 General:

- .1 Manufacture each access door assembly as an integral unit ready for installation.
 - .2 Recessed panel: Form face of the door to provide a recess for the application of the finish material. Reinforce the door as necessary to prevent sagging.
 - .3 Furnish the number of latches necessary to hold the door in a flush, smooth plane when closed.
 - .2 Hinge: Concealed, two-point hinge, non-corroding that allows the door to open 120 degrees.
 - .3 Latches: self-latching, tamper-resistant, recessed head, cam latch.
- 2.5 FINISH
- .1 Factory-applied primer.
- 3 EXECUTION**
- 3.1 INSTALLATION
- .1 Install access doors plumb and square, and flush with finished ceiling, in accordance with manufacturer's instructions.
 - .2 Ensure adequate bracing is present for support of access panel frame. Provide additional support as required.
 - .3 Adjust operable parts for correct function.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide upward acting, glazed aluminum sectional overhead doors, including:
 - .1 Door panels,
 - .2 Tracks and hardware,
 - .3 Vision lites,
 - .4 Door operators,
 - .5 Control mechanisms.

1.3 REFERENCE STANDARDS

- .1 ASTM A366; Specification for Steel Carbon, Cold-Rolled Sheet, Commercial quality.
- .2 ASTM-A591/A591M; Specification for Steel Sheet, Electrolytic Zinc-Coated for Light Coating Mass Applications.
- .3 ASTM A653/A653M; Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .4 ASTM A924/A924M; Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .5 CSA G164-M92; Hot-Dip Galvanizing of Irregular Shaped Objects.
- .6 CAN/CGSB-1.105-M91; Quick drying Primer.
- .7 CGSB 1-GP-181-M77; Coating, Zinc rich, Organic, Ready-mixed.
- .8 CAN/ULC-S702; Standard for Mineral Fibre Thermal Insulation for Buildings.
- .9 CAN/ULC-S704; Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced.

- .10 CAN/ULC-S770; Standard for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulation Foams.
- 1.4 DESIGN CRITERIA
 - .1 Design exterior door assembly to withstand windload of 1 kPa with a maximum horizontal deflection of 1/240 of opening width.
 - .2 Doors shall have a minimum thermal value of R6.
- 1.5 QUALITY ASSURANCE
 - .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
 - .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.6 SHOP DRAWINGS
 - .1 Submit shop drawings in accordance with Section 01 30 00.
 - .2 Indicate all door and hardware materials and finishes, operating mechanisms, required clearances and electrical connections.
- 1.7 MAINTENANCE DATA
 - .1 Provide operation and maintenance data for overhead door hardware for incorporation into Maintenance Manual.

2 PRODUCTS

2.1 PRODUCTS AND MANUFACTURER

- .1 Aluminum A175A-NDS, as manufactured by Northern Dock Systems Inc., Mississauga ON (905.625.1758).
- .2 Model AFV 452 overhead doors, as manufactured by Wayne-Dalton.

2.2 MATERIALS

- .1 Door Sections: Shall be of aluminum alloy 6063-T6, 35mm thick stiles and rails, joined with self-tapping screws.
- .2 Rails: Top and bottom rails with 89mm wide, lower intermediate rail 35mm, upper rail 41mm, minimum wall thickness 0.062mm.
- .3 Stiles: Top, bottom, and end stiles are 89mm wide, center stile 76mm wide, minimum wall thickness 1.6mm.
- .4 Glazing: 16mm, double skin cellular polycarbonate glazing.
- .5 Track: Track design shall be high lift. Vertical mounting angles shall be hot-dipped galvanized. Track size shall be 76mm. Vertical track shall be graduated to provide wedge type weathertight closing with continuous angle mounting for steel jambs, and shall be fully adjustable to seal door at jambs. Horizontal track shall be reinforced with continuous angle of adequate length and gauge to minimize deflection.
- .6 Hardware: Hinge and Roller Assembly:
 - .1 Hinges and brackets shall be made from hot-dipped galvanized steel.
 - .2 Track rollers shall be case-hardened inner steel races with 10-ball 76mm rollers.
 - .3 All factory authorized attachments shall be made at locations indicated.
- .7 Counterbalance:
 - .1 Springs shall be torsion type, low-stress, helical wound, oil-tempered spring wire to provide minimum 100,000 cycles of use, on continuous solid steel shaft.
 - .2 Spring fittings and drums made of die cast, high strength aluminum.
 - .3 Pre-formed galvanized steel aircraft cable shall provide a minimum of a 5:1 safety factor.
- .8 Weather Seals
 - .1 Doors shall be equipped with vinyl joint seals between sections and vinyl bulb shaped astragal provided on the bottom section. Optional top seal and jamb seal are available.
- .9 Locks
 - .1 Locks shall engage the right-hand vertical track and utilize an interior side lock.

2.4 SHOP FINISHING OF DOOR SYSTEM

- .1 Phosphatize all galvanized metal surfaces to provide for adhesion of finish paint. Clean all ferrous metal surfaces except working parts of machinery and faying surfaces and prime with a rust inhibitive primer. Clean supplementary steel supports and likewise, prime with a rust inhibitive primer.
- .2 Apply in the shop, specified paint system in accordance with manufacturer's standards. Finish system shall be applied to door curtain, hood, wall guides and all visible trim.
- .3 Finish Coating System: to include an ASTM A653 galvanized base coating, bonderized coating for prime coat adhesion, corrosion-inhibiting primer 0.2 mils per side, and thermosetting polyester top coat with a minimum thickness of 0.6 mils each side.
 - .1 Colour: as selected by the Consultant.

2.5 DOOR OPERATORS

- .1 Motor: 2 HP high starting torque industrial type protected by an integral thermal resistor. High voltage cables will be prewired to the motor and factory tested.
- .2 Reducer: shall have a patented anti-back drive feature to prevent the door from falling due to a failure of reducer components or the brake.
- .3 Door Limiters: shall be electronic encoder type to allow the door travel to be adjusted from the floor. There will be no limit adjustment required in the operator. The limit cable will be prewired to the operator and tested at the factory.
- .4 Hand Chain Back-up: provide emergency hand chain enabling the door to be operated manually in the event of power or motor failure.
- .5 DC powered disc brake will stop the door and hold it in place.
- .6 Control panel shall be UL approved and sized to accommodate the motor and the door speed. All functions will be displayed on an LCD screen, visible through the lid. The inverter drive controls the door with an adjustable soft start and stop function.
- .7 Push buttons shall be a flush mounted foil type mounted on the panel lid.
- .8 Power supply mounted in a separate fused panel.

2.6 DOOR OPERATION

- .1 Operators: SDI Safedrive electric motor with oil bath, worm gear reducer and patented anti-back drive feature. Equip operators with:
 - .1 Built-in chain hoist for manual operation in event of power failure. Include chain interlock auxiliary operator to disconnect motor mechanically and electrically when engaged and allow manual operation of door.
 - .2 Electrical motors, controller units, remote pushbutton stations, relays and other electrical components to CSA approval with CSA enclosure.
 - .3 Controller units: with integral motor reversing starter, solenoid operated brake, heater elements for overload protection, including pushbuttons and control relays as required.

- .4 Safety switch: electro mechanical or electro pneumatic device full length of bottom rail of bottom section of door, to reverse door to open position when coming in contact with object on closing cycle.
 - .1 Safety edge shall be installed on the bottom of the door and shall automatically reverse the door if the device detects an obstruction in the downward travel of the door.
 - .2 Safety edge shall consist of a rubber boot with an electrical switch. The safety edge shall operate with airwave technology and shall not rely on pneumatic pressure or electrical strip contacts. Once contacted, the safety edge shall create an airwave that will be detected and reverse the direction of the door.
 - .3 Operation of the safety edge shall not be subject to interferences by temperature, barometric pressure, water infiltration, or cuts in the rubber extrusion.
- .5 Photo-electric Beams: manufacturer's proprietary photo-electric safety devices; two sets per door opening (one high mount, one low).
- .6 Door Signal Lights: standard "traffic light" style; red and green lights, interior mounted, adjacent to each door opening. Lights linked to operators to show red upon activation of door, and remain red until door is in full open position, then changing to green.
- .7 Operator Timer/Switches: once door reaches full open position timer will hold door in open position for a programmable set time, and then return the door to its closed position.
- .8 Anti-Drop Device: Design anti-drop brake to stop and hold doors in any position, upon failure of normal operating device. A DC powered disc brake will stop the door and hold it in place.
- .9 Door Activation
 - .1 Exterior Doors at Apparatus Bay
 - .1 Primary Control: remote Dispatch Area operation of all doors from a central control panel (separate switches).
 - .2 Secondary Control: hand-held remote controls for truck cabs (2 remotes per door opening).
 - .3 Back-up Control: surface-mounted remote stations adjacent to inside of door openings; OPEN-STOP-CLOSE push buttons.

3 EXECUTION

3.1 EXAMINATION

- .1 Verify that existing conditions are ready to receive sectional overhead door work.
- .2 Beginning of sectional overhead door work means acceptance of existing conditions.

3.1 INSTALLATION

- .1 Install door complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports in accordance with final shop drawings, manufacturer's instructions, and as specified herein.
- .3 Installation shall be by a certified manufacturer's installer.
- .2 Install electrical motors, controller units, pushbutton stations, relays, and other necessary equipment required for complete door installation. Program hand-held remote controls, and number all units to correspond to doors.
- .3 Installation includes electric wiring from power supply located near door opening, and all low voltage switch and control wiring and terminations.
- .4 Lubricate springs and adjust door-operating components to ensure smooth opening and closing of doors. Adjust weather-strip to form weather-tight seal.
- .4 Fit, align and adjust sectional overhead door assemblies level and plumb for smooth operation.

3.2 TESTING & ADJUSTMENT

- .1 Upon completion of final installation lubricate, test and adjust doors to operate easily, free from warp, twist or distortion and fitting for entire perimeter.

3.3 DEMONSTRATION

- .1 Arrange and conduct full demonstration of door functions to Owner's representatives. Upon completion of demonstrations, turn over remote controls to Owner.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide exterior bi-folding sectional doors, including:
 - .1 Door panels,
 - .2 Tracks and hardware,
 - .3 Door operators,
 - .4 Control mechanisms.
 - .5 Factory–applied Finishes.
 - .6 Wiring and installation.

1.3 REFERENCE STANDARDS

- .1 Aluminum Association (AA); DAF-45, Designation System for Aluminum Finishes.
- .2 ASTM B209; Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 ASTM B221M; Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
- .4 CSA-G40.21; Structural Quality Steels
- .5 CAN/CSA G164; Hot Dip Galvanizing of Irregularly Shaped Articles.
- .6 CAN3-S157; Strength Design in Aluminum.
- .7 CSA W59.2; Welded Aluminum Construction.

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to

provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.5 SHOP DRAWINGS
 - .1 Submit shop drawings in accordance with Section 01 30 00.
 - .2 Indicate all door and hardware materials and finishes, operating mechanisms, required clearances and electrical connections.
- 1.6 MAINTENANCE DATA
 - .1 Provide operation and maintenance data for overhead door hardware for incorporation into Maintenance Manual.

2 PRODUCTS

2.1 MATERIALS

- .1 Aluminum Members: Alcan 6063-T54 alloy and temper.
- .2 Extruded Aluminum: to ASTM B221.
- .3 Sheet Aluminum: ASTM B209.
- .4 Screws, bolts and fasteners: 300 series stainless steel or 400 series stainless steel cadmium plated.
- .5 Sheet Steel: Zinc-iron Alloy (ZF) coated steel sheet to ASTM A653/A653M structural quality Grade A, with Z275 coating, for interior

surfaces not exposed to weather, unpainted finish, minimum 0.914mm base steel thickness.

- .6 Steel Reinforcement: to CAN/CSA-G40.21, grade 300W, as required by system design limitations.
- .7 Glazing gaskets: extruded, black, closed cell or dense elastomer of durometer appropriate to the function.
- .8 Sealants: to Section 07 92 00.
- .9 Isolation Coating: alkali resistant, epoxy resin solution.

2.1 BI-FOLDING DOORS

.1 Exterior Doors

- .1 Bi-Fold Doors: Two vertical panels hinged together, weather lapped at vertical joint, on roller and track system fixed to building structure to stack in a folded position at either jamb.
 - .1 Door Size: As indicated on Drawings.
- .2 Acceptable Products
 - .1 FF3300 Four Fold Doors (Glazed), by Northern Dock Systems Inc., Mississauga ON (905.625.1758).
- .3 Door Panels/Hardware – Thickness based on door size;
 - .1 2 1/8" inches thick constructed from 11-gauge structural steel tubing - Fiberglass Batt Insulation (R6.5) between all gaps in panel framing (Excludes insulation inside of tube frame)
 - .2 14-gauge steel sheeting interior and exterior. Sheeting shall be formed on the vertical edges with no visible welds on the interior or exterior panel faces.
 - .3 Jamb hinges shall be dual shear and have two thrust bearings and two needle bearings.
 - .4 Fold hinges shall be dual shear with two thrust bearings. Fold hinges shall be stainless steel
 - .5 Full Perimeter weather-seals including dual bottom sweeps with no exposed fasteners on the exterior.
 - .6 Connecting Rod disconnects for manual operation
- .4 Glazing
 - .1 Type: (1") 25mm insulated tempered safety glass (both lites). Pilkington's Energy Advantage Low-E (3).
- .5 Surface mounted tube frame:
 - .1 6"x4" pre-hung frame, designed to anchor to masonry wall construction or steel jambs.
 - .2 All hinges, track supports and operator supports are factory attached.
- .6 Operator and Controls

- .1 Overhead Mounted Electro-mechanical operator with limit switches & cover. Requires 18" of headroom
- .2 Incoming electrical: 208VAC, 60 Hz, 3 Phase (or alternate supply voltage as per project specifications)
- .3 NEMA 4 control panel with programmable door logic controller, pushbuttons (Open/Close/Stop), Hand/Auto Selector Switch and rotary disconnect
- .4 Control panel includes VFD to allow speed adjustment
- .5 Completely customizable Sequence of Operations to suit Owner's desired operation and function.
- .6 PLC to be installed in control panel cover for full visibility (PLC can be internally mounted in panel if preferred)
- .7 Full Height Electric Safety Edges (wired or wireless available)
- .8 Remote - NEMA Type 4 Push Button Station (Surface or Flush Mount)
- .9 Type NEMA Type 4 Thru Beam Photo Eyes - EMX IRB-4X – for surface mount Exterior or Interior Wall/Bollard Installation
- .10 Includes inputs for radio receivers (radio receivers and transmitters – type & # to be coordinated and furnished by NDS).
- .11 Safety/Hold Loop Detector (Loop wire by others) – if required
- .12 Open/Hold Loop Detector (Loop wire by others) – if required
- .13 Edwards signaling horn 877-G1 NEMA4x
- .14 LED Red/Green Traffic Lights

2.2 FINISHES

- .1 Factory Finish: Epoxy primer followed by polyurethane finish paint. Colour as selected by the Consultant.

2.3 DOOR OPERATION

- .1 Door operation shall be electrical motorized operation (with chain backup).
- .2 Electrical Operator
 - .1 Jackshaft Operators: provide floor level disconnect device to allow for manual operation in event of power failure. Equip operators with:
 - .1 Electrical interlock switch to disconnect power to operator when in manual operation.
 - .2 Built-in chain hoist for manual operation in event of power failure.
 - .2 Electrical motors, controller units, remote pushbutton stations, relays and other electrical components: to CSA approval with CSA enclosure.
 - .3 Controller Units: with integral motor reversing starter, solenoid operated brake, heater elements for overload protection, including pushbuttons and control relays as required.
 - .4 Safety Switch: electro mechanical or electro pneumatic device full length of jamb section of door, to reverse door to open position when coming in contact with object on closing cycle.

2.4 FABRICATION

- .1 Fabricate doors and frames from section of size and configurations shown on drawings.
- .2 Fabricate units square and true with maximum tolerance of plus or minus 1.5mm for units with a diagonal measurement of 1800mm or less and plus or minus 3mm for units with a diagonal measurement over 1800mm.
- .3 Face dimensions detailed are maximum permissible sizes.
- .4 Brace frames to maintain squareness and rigidity during shipment and installation.
- .5 Provide all internal reinforcing as required for the proper structural design and support of the door panels.
- .6 All joints shall be accurately machined, assembled and sealed.

3 EXECUTION

3.1 INSTALLATION

- .1 Install doors and hardware.
- .2 Touch-up doors where finish is damaged during fabrication.
- .3 Install electrical motors, controller units, pushbutton stations, relays, and other necessary equipment required for complete door installation.
- .4 Installation includes electric wiring from power supply located near door opening.
- .5 Adjust door-operating components to ensure smooth opening and closing of doors. Adjust weather-strip to form weather-tight seal.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide all glazed aluminum curtain wall systems including all associated frame reinforcing, opening preparation, structural steel clip angles, flashings, fastenings, and internal sealants.

1.3 REFERENCE STANDARDS

- .1 ASTM A653/A653M; Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .2 Aluminum Association (AA); DAF-45, Designation System for Aluminum Finishes.
- .3 American Architectural Manufacturers Association (AAMA); Aluminum Curtain Wall Design Guide Manual.
- .4 ASTM B209; Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .5 ASTM B221M; Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
- .6 ASTM E283; Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, Doors.
- .7 ASTM E330; Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

- .8 ASTM E331; Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 - .9 ASTM E1105; Test Method for Field Determination of Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference.
 - .10 CAN/CGSB-12.20; Structural Design of Glass for Buildings.
 - .11 CSA-G40.21; Structural Quality Steels
 - .12 CAN/CSA G164; Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .13 CAN3-S157; Strength Design in Aluminum.
 - .14 CSA W59.2; Welded Aluminum Construction.
 - .15 CAN/ULC-S702; Standard for Mineral Fibre Thermal Insulation for Buildings.
 - .16 CAN/ULC-S114; Determination of Non-combustibility of Building Materials.
- 1.4 QUALITY ASSURANCE
- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
 - .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor(Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
 - .5 Inspection and Testing
 - .1 Products and systems provided under this section may be subject to inspection and testing.

1.5 SYSTEM DESCRIPTION

- .1 Vertical aluminum curtain wall system includes thermally broken tubular aluminum sections insulated from exterior pressure plate, with self supporting framing, shop fabricated, factory sealed vision glass, glass spandrel panels, related flashings, anchorage and attachment devices.
- .2 Assembled system to permit re-glazing of individual glass units without requiring removal of structural mullion sections.

1.6 PERFORMANCE REQUIREMENTS

- .1 Structural performance shall be based on CAN3-S157, Strength Design in Aluminum, and a maximum deflection of 1/175 of the span.
- .2 Air infiltration shall not exceed $0.0003 \text{ m}^3/\text{s m}^2$ when tested in accordance with ASTM E283 at a pressure differential of 300Pa.
- .3 Design curtain walls to have no water infiltration when tested in accordance with ASTM E331 with a pressure differential of 720 Pa.
- .4 Design and size components to withstand dead and live loads caused by pressure and suction of wind, acting normal to plane of system, as calculated in accordance with the Ontario Building Code.
- .5 Where required by the design, design and fabricate curtain wall systems to function as a "guard" as defined by the Ontario Building Code.
- .6 Size glass units and glass dimensions to limits established in CAN/CGSB-12.20.
- .7 System to provide for expansion and contraction within system components caused by a cycling temperature range of 95°C over a 12-hour period without causing detrimental affect to system components.
- .8 Drain water entering joints, condensation occurring in glazing channels or migrating moisture occurring within system, to the exterior by a weep drainage network.
- .9 Maintain continuous air barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass.
- .10 System design shall be the responsibility of a Professional Engineer registered in the Province of Ontario.

1.7 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 30 00.

- .2 Indicate system dimensions, framed opening requirements and tolerances, adjacent construction, anticipated deflection under load, weep drainage network, expansion and contraction joints, and field welding required. Also indicate profiles of components, elevations, anchorage details, required reinforcing, location of isolation coating, description of related components, finishes and fasteners.
 - .3 Shop drawings shall bear the stamp of a Professional Engineer, registered in the Province of Ontario.
 - .2 Samples
 - .1 Submit 300 x 300mm sample representative of curtain wall system including prefinished framing, glass, metal panels and corner details.
- 1.8 EXTENDED WARRANTY
- .1 Submit a manufacturer's warranty certificate in the name of the Owner, warranting the curtain wall Products provided under this section, against defects in material or manufacture for a period of two (2) years from date of Substantial Performance.
- 2 PRODUCTS**
- 2.1 MANUFACTURERS
- .1 Curtain wall products and systems provided under this section must be from one manufacturer for frames, panels, and accessories.
 - .2 Products and systems provided under this section must be from same manufacturer as products provided under Section 08 11 16.
- 2.2 MATERIALS
- .1 Aluminum Members: Alcan 6063-T54 alloy and temper.
 - .2 Extruded Aluminum: to ASTM B221.
 - .3 Sheet Aluminum: ASTM B209.
 - .4 Screws, bolts and fasteners: where used with aluminum shall be of 300 series stainless steel or 400 series stainless steel cadmium plated.
 - .5 Sheet Steel: Zinc-iron Alloy (ZF) coated steel sheet to ASTM A653/A653M structural quality Grade A, with Z275 coating, for interior surfaces not exposed to weather, unpainted finish, minimum 0.914mm base steel thickness.
 - .6 Steel Reinforcement: to CAN/CSA-G40.21, grade 300W, as required by system design limitations.

- .7 Vision Glass: refer to Section 08 80 00.
- .8 Spandrel Glass: refer to Section 08 80 00.
- .9 Glazing gaskets: extruded, black, closed cell or dense elastomer of durometer appropriate to the function.
- .10 Glazing Sealants: refer to Section 08 80 00.
- .11 Insulation: Semi-rigid mineral fibre, processed from rock, slag, or glass to CAN/ULC-S702 Type 1, non-combustible to CAN/ULC-S114, thickness to fill full depth of back pan;
 - .1 Roxul CurtainRock, by Roxul Inc.
 - .2 701 FIBREGLAS Insulation, by Owens Corning Canada Inc.
- .12 Perimeter Foam Sealant: single component polymeric low-expansion insulating sealant;
 - .1 Great Stuff PRO™, by Dow Chemical Company.
 - .2 CF812, by Hilti Corporation.
- .13 Isolation Coating: alkali resistant, epoxy resin solution.

2.3 VERTICAL GLAZING SYSTEMS

- .1 Exterior Curtain Wall
 - .1 Thermally broken aluminum curtain wall system, glazing, anchors and all related components for a capped and glazed system.
 - .2 Extruded aluminum, thermally-broken for double glazing, vertical curtain wall glazing system as follows:
 - .1 Structural & Intermediate Mullions: 64mm wide nominal dimension for framing members (depth as per engineered design), with exterior pressure plate and 19mm deep prefinished aluminum snap-on exterior caps.
 - .2 Provide for Structural Silicone Glazed system also where noted on the drawings.
 - .3 Spandrel Panels: Composite construction with 0.91mm hot-dip galvanized sheet steel back pan, gasketed into framing system, with standard insulation stick pins adhered to pan to hold 75mm mineral wool insulation;
 - .1 Exterior face sheets
 - .1 Spandrel glass glazed into framing system.
 - .2 Interior face sheets
 - .1 3mm Aluminum interior face sheet. Finish to match frames.

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- .3 Acceptable Products
 - .1 ThermaWall 2600 Series Curtain Wall, by Alumicor Limited.
 - .2 1600UT™1 Series Curtain Wall, by Kawneer Company Canada Ltd.
 - .3 Reliance HTC Curtain Wall, by Oldcastle Building Envelope.
 - .4 Series 8200 by Commdoor.
 - .2 Provide all closure panels, corners panels, infills and aluminum flashing related to curtain wall in 3mm thick sheet aluminum, finished to match frames.
- 2.4 VENTILATORS
- .1 Concealed Frame Vents: extruded aluminum, ventilating sash, thermally broken for double glazing; rain screen design, integral cam handle operator and 2-point lock, fibreglass insect screen and complete perimeter weather-stripping; CAN/CSA-A440 Ratings – A3, B7, C5. Acceptable Products are:
 - .1 5000 Phantom Vent, by Alumicor Limited.
 - .2 1600 GLASSvent, by Kawneer Company.
 - .3 Zero Sightline Vent, by Oldcastle Building Envelope.
- 2.5 ACCESSORIES
- .1 Expansion Connector: Exterior Santoprene gasket and interior EPDM gasket set in extruded aluminum section; High Expansion Connector by Alumicor Limited or equivalent by other listed manufacturer. Aluminum finish to match adjacent curtain wall sections.
 - .2 Firestopping:
 - .1 Mineral Fibre Safing Insulation: Complete with galvanized steel installation clips similar to Firebarrier Firestopping manufactured by Double A/D Distributors Limited Toronto, or Fibrex Safing Insulation manufactured by Fibrex Insulations Inc. Firestopping shall be 25% to 33% wider than the space to be filled.
 - .2 Firestopping Sealant: Sealant shall be ULC labelled and installed as per applicable ULC JF listing. Sealant shall be a single component self levelling silicone capable of bonding to all adjacent substrates, concrete, mild steel, aluminum, galvanized metal and PVC. Acceptable manufacturers are:
 - .1 GE Silicones.
 - .2 Hilti.
 - .3 Dow Corning Ltd.
 - .4 Tremco Limited.
 - .5 3M Corporation.

- .3 Provide all closure panels, corners, cover panels, infills and aluminum flashing related to curtain wall in 3mm thick sheet aluminum finished to match frames.

2.6 FINISH

- .1 Anodized: Class 1 anodic colour coating to AA-M12C22A42/44; #29 Black.

2.7 FABRICATION

- .1 Fabricate from extrusions of size and configurations shown on drawings.
- .2 Vertical and horizontal members shall be tubular extrusions, designed for shear block corner construction.
- .3 Brace pre-assembled frames to maintain squareness and rigidity during shipment and installation.
- .4 Provide all internal reinforcing as required for the proper structural design and support of the framing system.
- .5 All joints shall be accurately machined, assembled and sealed to provide neat weathertight joints.
- .6 Shielded drainage and pressure equalization vents shall be provided where required. All horizontal members shall be sealed to vertical members to provide individual compartments within the system in accordance with the rain screen principle.

3 EXECUTION

3.1 INSTALLATION

- .1 Erect and anchor all frames square and level using concealed fastenings where possible.
- .2 Anchors to be built into the structure shall be provided to the General Contractor for setting in accordance with the approved shop drawings.
- .3 Frames shall be installed, glazed and adjusted by experienced personnel in accordance with the manufacturer's instructions and reviewed shop drawings.
- .4 All items in this Section shall be set in their correct location and shall be set level, square, plumb and at proper elevations and in alignment with other work.

3.2 ISOLATION COATING

- .1 Isolate aluminum from following components, by means of isolation coating:
 - .1 All dissimilar metals except stainless steel, zinc, or white bronze.
 - .2 Concrete, masonry, and mortar.
 - .3 Untreated wood.

3.3 CAULKING

.1 Apply internal and glazing sealants in accordance with Section 08 80 00.

3.4 CLEANING

.1 During installation, remove all corrosive or foreign materials or droppings resulting from work of this or other trades.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 Subcontractors involved in the work of this section shall examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Construction Manager for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide all aluminum windows including the following:
 - .1 Window hardware,
 - .2 Operable vents (with insect screens),
 - .3 Aluminum closure panels,
 - .4 aluminum sills, and
 - .5 Internal sealants and caulking.

1.3 REFERENCES

- .1 Aluminum Association (AA); DAF-45, Designation System for Aluminum Finishes.
- .2 ASTM B209-01; Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 ASTM B221M-00; Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
- .4 ASTM E283, Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.
- .5 ASTM E330, Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors.
- .6 ASTM E331-00; Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

- .7 ASTM E1105-00; Test Method for Field Determination of Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference.
- .8 CAN/CSA-A440.2-M1991, Energy Performance Evaluation of Windows and Sliding Glass Doors.
- .9 CAN3-S157, Strength Design in Aluminum.

1.4 PERFORMANCE REQUIREMENTS

- .1 Structural performance shall be based on CAN3-S157, Strength Design in Aluminum, and a maximum deflection of 1/175 of the span.
- .2 Air infiltration shall not exceed $0.0003 \text{ m}^3/\text{s m}^2$ when tested in accordance with ASTM E283 at a pressure differential of 300Pa.
- .3 Design and size components to withstand dead and live loads caused by pressure and suction of wind acting normal to plane of system, as calculated in accordance with the Ontario Building Code.
- .4 Window frames shall meet the following minimum performance criteria in accordance with CAN/CSA A440:
 - .1 Perimeter Frames
 - .1 Air Tightness: A3/fixed
 - .2 Water Tightness: B7
 - .3 Wind Load Resistance: C4
 - .2 Vent Frames
 - .1 Air Tightness: A3
 - .2 Water Tightness: B7
 - .3 Wind Load Resistance: C4
- .5 System to provide for expansion and contraction within system components caused by a cycling temperature range of 95°C over a 12 hour period without causing detrimental affect to system components.
- .6 Drain water entering joints, condensation occurring in glazing channels or migrating moisture occurring within system, to the exterior by a weep drainage network. All proprietary internal drainage systems must be vented and drained to the exterior of the building envelope. All horizontal members shall be sealed to vertical members to provide individual compartments within the system in accordance with the rain screen principle
- .7 Maintain continuous air barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass.

1.5 SUBMITTALS

- .1 Prior to preparation of shop drawings submit a letter from the system manufacturer, certifying that the subcontractor has issued a purchase order, letter of intent or otherwise entered into a contract with the manufacturer. The letter must be dated and include:
 - .1 Name of project.
 - .2 Name of subcontractor.
 - .3 Complete list of product series or style.
 - .4 Manufacturer's contact with telephone and telefax numbers.

- .2 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 30 00.

 - .2 Indicate materials and large scale details for profiles of components, elevations of unit, anchorage details, required reinforcing, location of isolation coating, description of related components, finishes and fasteners.

- .3 Samples
 - .1 Submit 300 x 300mm sample representative of window frame system including prefinished framing, glass, metal panels, operable vents, and corner detail. Submit samples of all available sill profiles for selection by the Construction Manager.

- .4 Product Data
 - .1 Submit product data for the following, in accordance with Section 01 30 00:
 - .1 Material composition
 - .2 Finishes
 - .3 Hardware requirements

- .5 Test Reports
 - .1 Submit test report from approved independent testing laboratory, certifying windows comply to performance requirements of CAN/CSA-A440.2, and this specification.

1.6 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified

herein, warranty requirements, and in accordance with generally accepted, industry best practices.

- .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- .5 Mock-up
 - .1 Supply and install one full window in place, for review by the Construction Manager in accordance with Section 01 40 00.
 - .2 Construct mock-up to include all components including vision glass, aluminum sill, and all sealants.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Do not deliver aluminum windows to the site until installation can commence, or until adequate secure storage is provided.
- .2 Deliver all window frames shrink-wrapped in polyethylene. Do not remove wrapping until time of installation.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 Products and systems provided under this section must be from one manufacturer for window frames, operable vents, sills, and infill panels.

2.2 MATERIALS

- .1 Aluminum Members: Alcan 6063-T54 alloy and temper.
- .2 Screws, bolts and fasteners: for use with aluminum; 300 series stainless steel or 400 series stainless steel cadmium plated.
- .3 Glazing gaskets: extruded black EPDM, of sufficient durometer hardness.
- .4 Glazing Tape: exterior glazing; Tremco POLYSHIM II.

- .5 Vision Glass: refer to Section 08 80 00.
- .6 Reinforcing, Supports and Anchors: aluminum or hot-dip galvanized steel.
- .7 Sealants: refer to section 07 92 00.
- .8 Isolation coating: alkali resistant, epoxy resin solution.
- .9 Aluminum Trim: minimum 1.52mm aluminum, finish to match windows.
- .10 Perimeter Foam Sealant: single component polymeric low-expansion insulating sealant;
 - .1 Great Stuff PRO™, by Dow Chemical Company.
 - .2 CF812, by Hilti Corporation.

2.3 EXTERIOR WINDOWS

- .1 Frames: extruded aluminum, thermally broken, fixed perimeter frames, minimum 133mm frame depth for double glazing;
 - .1 Acceptable Products
 - .1 RainBlade 1970 by Alumicor Limited.
 - .2 518 IsoPort™ Series by Kawneer Company Canada Ltd.
 - .3 Series 435 by C.R. Laurence (United States Aluminum of Canada).
 - .4 525 Series by Commdoor Aluminum.
 - .2 Operable Vents: extruded aluminum, thermally broken for double glazing; open-in 'hopper style' ventilators, with two-point cam handle locks, aluminum insect screens, and complete perimeter weatherstripping;
 - .1 Acceptable Products
 - .1 Univent 1350 Series by Alumicor Limited.
 - .2 526 IsoPort™ Series by Kawneer Company Canada Ltd.
 - .3 Series 8250 by C.R. Laurence (United States Aluminum of Canada).
 - .4 225 Series by Commdoor Aluminum.

2.4 ACCESSORIES

- .1 Infill Panels: Prefinished aluminum sheets 3mm thick formed as detailed, supplied and installed on concealed aluminum support angles, with concealed fasteners. Colour and finish to match window frames.
- .2 Sills: Prefinished extruded aluminum, as shown on drawings; colour and finish to match exterior finish of window frames. **Site-fabricated bent aluminum plate/sheet sills are not acceptable.**
 - .1 Drip deflectors (end dams) at all ends.
 - .2 Joint covers where sills are not continuous lengths, and at mitres.

- .3 Align intermediate joints with mullions.
- .4 Round off all protruding edges and corners.

- .3 Spandrel Panels: Prefinished aluminum sheets 3mm thick, bonded to both sides of 25mm thick expanded polystyrene (EPS) insulation, glazed into frame with removable stops and seals. Spandrel panels must be removable from the exterior.

2.5 ALUMINUM FINISH

- .1 Anodized: Class 1 anodic colour coating to AA-M12C22A42/44; #29 Black.

2.6 FABRICATION

- .1 Fabricate window frames from extrusions of size and configurations shown on drawings.
- .2 Fabricate in accordance with CAN/CSA-A440 supplemented as follows:
 - .1 Fabricate units square and true with maximum tolerance of plus or minus 1.5mm for units with a diagonal measurement of 1828mm or less and plus or minus 3mm for units with a diagonal measurement over 1828mm.
 - .2 Face dimensions detailed are maximum permissible sizes.
 - .3 Brace frames to maintain squareness and rigidity during shipment and installation.
 - .4 Provide all internal reinforcing as required for the proper structural design and support of the framing system.
 - .5 All joints shall be accurately machined, assembled and sealed to provide neat weathertight joints
 - .6 Shielded drainage and pressure equalization vents shall be provide where required to provide external drainage as specified. All horizontal members shall be sealed to vertical members to provide individual compartments within the system in accordance with the rain screen principle.
 - .7 Window framing shall consist of thermally broken sections with fixed glazing stop on exterior side, and snap-in glass stop on interior side. Provide mullion sections (closed) for all perimeter head, jamb and sill applications; with outer glazing leg cleanly cut off. No open sections are permitted.

3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with CAN/CSA-A440.
- .2 Erect and anchor all frames square and level using concealed fastenings where possible.

- .3 Anchors to be built into the structure shall be provided to the General Contractor for setting in accordance with the approved shop drawings.
- .4 Frames shall be joined by coupling the split interlocking mullions after bedding compound has been applied to the female section.
- .5 After erection, all operating windows shall be checked and adjusted to ensure smooth and proper operation.
- .6 Manufacturer' name plates or labels shall not be installed on exterior of windows.

3.2 ISOLATION COATING

- .1 Isolate aluminum from following components, by means of isolation coating:
 - .1 All dissimilar metals except stainless steel, zinc, or white bronze.
 - .2 Concrete, masonry, and mortar.
 - .3 Wood.

3.3 CAULKING & SEALS

- .1 Fill all voids between window frames and building components with foam sealant. Allow for caulking and backer rod application.
- .2 Seal joints between windows and window sills with sealant. Bed sill expansion joint cover plates and drip deflectors in bedding compound. Caulk between sill upstand and window-frame. Caulk butt joints in continuous sills.
- .3 Apply sealants to full perimeter of interior and exterior of frames in accordance with Section 07 92 00.

3.4 CLEANING

- .1 During installation, remove all corrosive or foreign materials or droppings resulting from work of this or other trades.
- .2 Perform initial cleaning operation of all window frames upon completion of installation. Remove all remaining labels, protective films, or other surface imperfections.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Tubular skylights, consisting of skylight dome, reflective tube, and diffuser assembly; configuration as indicated on the drawings.

1.3 REFERENCES

- .1 AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/ Specification for Windows, Doors, and Skylights (NAFS)
- .2 CSA A440S1-09 – Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440
- .3 AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems
- .4 AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
- .5 ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- .6 ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- .7 ASTM D 635 - Test Method for Rate of Burning and/or Extent of Time of Burning of Self-supporting plastics in a Horizontal Position
- .8 ASTM D 2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics
- .9 ASTM D 4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free
- .10 ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- .11 ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings

- .12 ASTM E 283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
- .13 ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
- .14 ASTM E 408 - Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques
- .15 ASTM E 1651 - Standard Test Method for Total Luminous Reflectance Factor by Use of 30/t Integrating-Sphere Geometry
- .16 ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
- .17 ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

1.4 PERFORMANCE REQUIREMENTS

- .1 Daylighting: Provide daylighting photometric performance comparable to basis of design product at layout indicated, based upon daylighting profile of March 21, 9:00 am local time, at Project location by simulation in accordance with IESNA guidelines.
- .2 Air Infiltration: Maximum air leakage through unit of 0.09 cfm/sq. ft. (0.5 L/s/sq. m) of fixed area as determined according to ASTM E 283 at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa.)
- .3 Water Penetration under Static Pressure: No evidence of water penetration through complete unit when tested according to ASTM E 331 at a static-air-pressure differential of 15 lbf/sq. ft. (720 Pa).
- .4 Thermal Performance Standards: NFRC 100 and 200:
 - .1 Curb-flashed Energy Star tubular unit skylights:
 - .1 U-Factor: 0.38 Btu/hr*ft.*deg. F (2.10 W/m²*deg K).
 - .2 Solar Heat Gain Coefficient (SHGC): 0.25.
- .5 Surface-Burning Characteristics of Plastic Glazing and other plastic components: Provide plastic glazing meeting NAFS and identical to specimens tested for fire-exposure behavior in accordance with test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - .1 Self-Ignition Temperature: 650 deg F (345 deg. C) or more for plastic glazing in thickness indicated when tested per ASTM D 1929.
 - .2 Smoke-Production Characteristics: Comply with either requirement below:
 - .1 Smoke-Developed Index: 450 or less when tested per ASTM E 84 on plastic glazing in manner indicated for application.
 - .2 Smoke Density: 75 or less when tested per ASTM D 2843 on plastic glazing in thickness indicated for application.

- .3 Burning Characteristics: Tested and labeled in accordance with ASTM D 635.
 - .1 Plastic Glazing for Domes: Polycarbonate Class CC1.

 - .6 Fire Ratings for Roof Assemblies with Fire Classifications: Tubular unit skylight with dome edge protection band, and pass testing in accordance with the Class B Burn Brand portion of ASTM E 108 for use on roofs with Class A, B or C roof assemblies.
- 1.5 SUBMITTALS
- .1 Submit under provisions of Section 01 30 00.

 - .2 Product Data: Manufacturer's data sheets on each product to be used, including:
 - .1 Preparation instructions and recommendations.
 - .2 Storage and handling requirements and recommendations.
 - .3 Installation methods.

 - .3 Shop Drawings: For tubular unit skylight work. Include plans, elevations, sections, details, and connections to supporting structure and other adjoining work.
 - .1 Lighting photometric study indicating compliance with performance requirements in accordance with IESNA. Include layout, spacing criteria and foot-candle report.

 - .4 Verification Samples: As requested by Consultant.

 - .5 Test Reports: Independent testing agency or evaluation service reports verifying compliance with specified performance requirements.
- 1.6 QUALITY ASSURANCE
- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

 - .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.

 - .3 Documentation
 - .1 If requested, submit documentation to support the competency of firms and personnel.

- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Store products in manufacturer's unopened packaging until ready for installation.

1.8 PROJECT CONDITIONS

- .1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 EXTENDED WARRANTY

- .1 Provide Manufacturer's warranty certificate warranting skylight products from manufacturing defects for a period of 10 years from Date of Substantial Performance. Warrant tunnel reflective coating for 20 years from Date of Substantial Performance.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Basis-of-Design Product: VELUX Sun Tunnel, by VELUX America LLC, Greenwood, SC 29648; www.VELUXusa.com; (800) 888-3589.

2.2 MATERIALS

- .1 Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, either commercial steel or forming steel.
- .2 Aluminum Sheet: Flat sheet complying with ASTM B 209 (ASTM B 209M).
- .3 Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic, nominally free of sulfur and containing no asbestos fibers.
- .4 Joint Sealants: As specified in Section 07 92 00.
- .5 Mastic Sealants: Polyisobutylene; non-hardening, non-skinning, non-drying, non-migrating sealant.
- .6 Roofing Cement: ASTM D 4586, asbestos free, designed for trowel application or other adhesive compatible with roofing system.

2.3 TUBULAR SKYLIGHTS

- .1 General: Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly; complying with ICBO/ICC AC-16. All components made and assembled by one manufacturer;
 - .1 VELUX SUN TUNNEL Skylight Kit Model TCR-014 (14")356mm Tubes: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
- .2 Roof Dome Assembly:
 - .1 Glazing: (0.080")2.03mm minimum thickness polycarbonate classified as CC1 material.
- .3 Flashing Base: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube;
 - .1 Curb-flashed Configuration: One-piece formed, minimum 0 to 60 deg. roof pitch.
 - .2 Base Material: Sheet steel, corrosion resistant meeting ASTM A653/A653M or ASTM A463/A463M, (0.028")0.7mm thick, (6")152mm high.
 - .3 Base Pitch (Slope): Flat, no pitch.
- .4 Intermediate Ring: High-impact plastic reflective tunnel receiver attached to top of roof flashing serving as mounting base for dome assembly and providing a thermal break between flashing and reflective tunnel, configured to channel condensed moisture out of assembly.
 - .1 Intermediate Ring Seal: Santoprene O-ring providing weather tight seal with roof flashing.
 - .2 Pivot Ring and Reflective Tunnel Collar: High-impact polymer pivoting socket mounted in intermediate ring and secured to factory-installed reflective tunnel collar 3.625 inch (92 mm) in height; adjustable for tunnel section alignment.
- .5 Reflective Tunnels
 - .1 Rigid Reflective Tunnel: Skylight light shaft formed from anodized aluminum sheet, 0.016-inch/26-ga.- (0.41-mm-) thick, with silver specular interior finish surface coated with vacuum-evaporated silicone oxide and titanium oxide protective surface.
 - .2 Length: as required by ceiling space height.
 - .3 Diameter: As required for indicated flashing assembly sizes.
 - .4 Reflectance: 99 percent reflectance when measured in accordance with ASTM E 1651 at 30 degrees from vertical. Total reflectance greater than 98 percent when measured in accordance with ASTM E 1651.
 - .5 Color Rendition, ASTM E 408: As defined by CIE L*a*b* color model, L equal to 99-100, values a* and b* shall not exceed +1 or be less than -1.
 - .6 Rigid Tunnel Components:
 - .1 Rigid Tunnel Extensions: 24" (610mm lengths).
 - .2 Universal Reflective Elbows: Two reflective angle adaptors adjustable to 45 degrees, 11.5 inch (392 mm) length, 0.02 inch/24 ga. (0.51 mm) thick, and mounted at the top, middle,

- or bottom of reflective tunnel assemblies as required for application.
- .7 Rigid Tunnel Fastening System: Manufacturer's recommended fastening devices consisting of spring tempered stainless steel pull clip mechanical fasteners allowing tunnel vertical and horizontal joints to be secured without the use of screws or tools, used in conjunction with pre-located punched holes in tunnel sections, that allow for a tight naturally-occurring tapered mating of interconnecting tunnel sections and elbows.
 - .1 Basis of Design: VELUX Flexi-Loc Fasteners.
 - .8 Reflective Tunnel Accessories: Provide accessories indicated and as required for installation based upon roof, ceiling, and structural member configuration, skylight and diffuser locations indicated on Drawings, and manufacturer's recommendations, selected from the following:
 - .9 Rigid Tunnel Extensions: Reflective rigid extension tunnel, 24 inch (610 mm) lengths fastened as required for application length.
 - .10 Basis of Design: VELUX Model ZTR Rigid Reflective Tunnel.
 - .6 Diffusers
 - .1 Round ceiling diffuser assembly attached directly to bottom of reflective tunnel, with dual high visible light transmittance lenses separated by airtight seals providing insulating airspace, and paintable white acrylic trim ring.
 - .1 Size: As required for flashing assembly indicated.
 - .2 Lens Type: Crackle lens above frosted lens, minimum 92 percent visible light transmittance.
 - .2 Residential Energy Kit: Energy-Star-compliant diffuser consisting of two clear diffusers mounted in airtight Santoprene gasketing system inserted in a round polymer housing serving as thermal break in line with ceiling insulation.
 - .1 Include semi-transparent heat shield configured to reduce solar heat gain at high solar angles.
 - .2 Basis of Design: VELUX Energy Kit Model ZTC 41.
 - .3 Diffuser Accessories:
 - .1 Prismatic lens, minimum 92 percent visible light transmittance
 - .2 Fresnel lens with concentric honeycomb parabolic light-diffusing prisms.
 - .4 Decorative Diffusers: Ceiling level diffuser consisting of metal trim ring and translucent white glass globe.
 - .1 Basis of Design: VELUX Decorative Diffuser Model ZTB 4006.
 - .2 Metal Trim Finish: White.

2.4 FINISHES

- .1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- .2 Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are

acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- .3 Galvanized Steel Sheet:
 - .1 Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - .1 Colour: Neutral gray.

2.5 ACCESSORIES

- .1 Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.
- .2 Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer.

3 EXECUTION

3.1 EXAMINATION

- .1 Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- .2 Proceed with tubular unit skylight installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- .1 Install tubular unit skylights in accordance with manufacturer's written instructions and approved shop drawings. Coordinate installation of units with installation of substrates, air and vapour retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that finished installation is weathertight.
- .2 Anchor tubular unit skylights securely to supporting substrates.
- .3 Where metal surfaces of tubular unit skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation recommended in writing by tubular unit skylight manufacturer.
- .4 Install tubular unit skylight curb counter flashing to produce weatherproof seal with curb and overlap with roofing system termination at top of curb.

3.3 FIELD QUALITY CONTROL

- .1 Test for water leaks according to AAMA 501.2 after installation and curing of sealants but prior to installation of interior finishes.

- .2 Perform test for total area of each tubular unit skylight.
- .3 Work will be considered defective if it does not pass tests and inspections.
- .4 Additional testing and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 **CLEANING AND PROTECTION**

- .1 Clean exposed tubular unit skylight surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- .2 Replace glazing that has been damaged during construction period.
- .3 Protect tubular unit skylight surfaces from contact with contaminating substances resulting from construction operations.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to supply finish hardware, including the following:
 - .1 Supply and delivery to the project all items of architectural finishing hardware specified herein,
 - .2 Supply and installation of low-energy door operators and hardware,
 - .3 Supply and installation of all electrical hardware items including, but not limited to; low voltage wire (FT6 plenum-rated when not in conduit), maglocks, electric strikes, electric exit devices, current transfer devices, wall switches, jamb switches, keypads, controllers, power supplies, and
 - .4 Completion of all low voltage terminations by the hardware supplier.

1.3 REFERENCE STANDARDS

- .1 Canadian Metric Guide for Steel Doors and Frames; Canadian Steel Door and Frame Manufacturers' Association.
- .2 ANSI/DHI A115.1G-94; Installation Guide for Doors and Hardware.
- .3 CAN/CGSB 69.18-M90/ANSI/BHMA-A156.1; Butts & Hinges.
- .4 ANSI/BHMA-A156.2-1996; Bored & Preassembled Locks & Latches.
- .5 CAN/CGSB CAN/CGSSB-69.19-93/ ANSI/BHMA-A156.3; Exit Devices.
- .6 CAN/CGSB 69.20-M90/ANSI/BHMA-A156.4; Door Controls – Closers.
- .7 CAN/CGSB 69.21-M90/ANSI/BHMA-A156.5; Auxiliary Locks.

- .8 CAN/CGSB 69.22-M90/ ANSI/BHMA-A156.6; Architectural Door Trim.
- .9 CAN/CGSB 69.23-M90/ ANSI/BHMA-A156.7; Hinge Templates.
- .10 CAN/CGSB 69.26-96/ ANSI/BHMA-A156.10; Power Operated Pedestrian Doors.
- .11 CAN/CGSB 69.29-93/ ANSI/BHMA-A156.13; Mortise Locks & Latches.
- .12 CAN/CGSB 69.31-M89/ ANSI/BHMA-A156.15; Closer Holder Release Devices.
- .13 CAN/CGSB 69.34-93/ ANSI/BHMA-A156.18; Materials & Finishes.
- .14 CAN/CGSB 69.35-M89/ ANSI/BHMA-A156.19; Power Assist and Low-Energy Power-Operated Doors.
- .15 CAN/CGSB 69.36-M90/ ANSI/BHMA-A156.20; Strap & Tee Hinges and Hasps.
- .16 CAN/CGSB 69.37-93/ ANSI/BHMA-A156.21; Thresholds.
- .17 ANSI/BHMA-A156.22; Gasketing and Edge Seal Systems.
- .18 ANSI/BHMA-A156.23; Electromagnetic Locks.
- .19 ANSI/BHMA-A156.26; Continuous Hinges.
- .20 ANSI/BHMA-A156.28; Keying Systems.
- .21 ANSI/BHMA-A156.29; Exit Lock and Alarms.
- .22 ANSI/BHMA-A156.30; Mortise Locks.
- .23 ANSI/BHMA-A156.31; Electric Strikes.

1.4 DEFINITIONS

- .1 Architectural Hardware Consultant (AHC): person or persons skilled in selecting, coordinating and specifying architectural hardware, and certified by the Door and Hardware Institute.
- .2 Hardware Supplier: company or group of companies whose purpose is the manufacture and supply of architectural finish hardware.
- .3 Hardware Distributor: company whose purpose is the distribution of architectural finish hardware.

1.5 QUALITY ASSURANCE

- .1 Products
 - .1 Products specified herein are minimum standard. Approved substitutions are listed.
 - .2 Hardware for doors in fire separations and exit doors must be certified by a Canadian Certification Organization accredited by Standards Council of Canada. Supply only ULC and/or CSA listed electrical components.
- .2 Hardware Suppliers

- .1 Hardware Suppliers must have in their employ a certified Architectural Hardware Consultant (AHC) certified by the Door and Hardware Institute.
- .2 The Hardware Supplier will provide following services to the Contract:
 - .1 preparation of the hardware schedule issued for tender,
 - .2 review of all shop drawings,
 - .3 provision of requested samples,
 - .4 review of hardware substitution submittals, and
 - .5 provision of all inspections and reports as specified herein.
- .3 Hardware Distributors
 - .1 The Distributor must have a minimum of five (5) years documented experience in the supply of Finish Hardware for similar projects.
 - .2 Hardware Distributors must have in their employ a certified Architectural Hardware Consultant (AHC) certified by the Door and Hardware Institute.
 - .3 The Hardware Distributor will assume responsibility that the Products supplied under this section meet or exceed the minimum requirements of the specifications, the hardware schedule, and all authorities having jurisdiction.
 - .4 Hardware Distributors must be approved by the Consultant prior to submitting a bid, and must extend all applicable manufacturers' warranties to the Contract.
- .4 Installers
 - .1 Hardware Installers must have a minimum of five (5) years experience in installation of hardware. The Contractor shall provide verification of installer's qualification to the Consultant for approval. Installers to attend all review meetings with the Hardware Supplier and Distributor.
- .5 Pre-installation Meeting
 - .1 Convene a pre-installation meeting for the work specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Installation Subcontractor (Site Foreman & Project Manager)
 - .3 Hardware Supplier (AHC)
 - .4 Hardware Distributor (AHC and Installer)

.5 Related Subcontractors (ie. Electrical, Security Systems)

1.6 SUBMITTALS

- .1 Updated Finish Hardware Schedule
 - .1 Prepare and submit six (6) complete detailed hardware schedules prepared in 216mmx279mm DHI format.
- .2 Product Data
 - .1 Provide in a three ring binder six (6) copies of product data sheets with the finish hardware schedule showing all items of hardware to be used on the project.
- .3 Samples
 - .1 When requested in writing, provide one sample of each hardware item requested complete with fasteners to the office of the Consultant. Samples to be clearly labeled with their hardware schedule designation and manufacturers' name and model number. Samples may be incorporated into the Work.
- .4 Templates
 - .1 Provide other sections with two (2) complete sets of hardware templates for related fabricating and installation.
- .5 Keying Schedule
 - .1 Provide three (3) copies of keying schedule for review. Include all special keying notes and stamping instructions. Locks and cylinders are not to be ordered until the key schedule has been approved by the Owner.
- .6 Wiring Diagrams
 - .1 Provide a written description of the functional use of all electrical hardware. Include door and frame elevations showing the location of each item of electrical hardware to be installed, including a diagram showing number and size of all conductors. Include drawings showing all terminal connections. Where electrical hardware is to be supplied and installed provide the Contractor with riser diagrams listing the correct wire runs and back box sizes as well as 115V AC requirements.
- .7 Operations and Maintenance Data
 - .1 Prior to Substantial Performance, provide two (2) copies of the following information for inclusion in Operation And Maintenance Manuals in accordance with Section 01 78 00:
 - .1 Maintenance instructions for each hardware item,

- .2 Catalogue cut sheets and Product Specifications or each product,
 - .3 Parts list for each product,
 - .4 Copy of final "as-built" finish hardware schedule, and
 - .5 Copy of final keying schedule.
- .8 Maintenance Materials
- .1 Provide the following maintenance materials in accordance with Section 01 78 00:
 - .1 Five (5) of each installation tool used for locks/passage/privacy, all type of door closers, and all exit devices.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- .1 Deliver each hardware item in its original package complete with all fasteners, keys, templates, and installation instructions required for installation.
 - .2 Package hardware separately for each door or unit and state clearly on each package the number and description of the door or unit for which the hardware therein is intended. Group items accordingly.
 - .3 Clearly mark each container with the door opening number and the hardware schedule item or heading number.
 - .4 Store hardware in a locked room or other secure area, accessible by only the Construction Manager. Storage area must contain adequate storage provision to hold all hardware off the floor (temporary shelving or wood pallets). Ensure area is kept dry and clean.
 - .5 When requested, package items of hardware separately for delivery to other fabricators for their installation.
 - .6 Deliver and assist in unloading and sorting of hardware. All hardware must be checked in on site by the Construction Manager's Site Supervisor.
- 1.8 COORDINATION WITH OTHER TRADES
- .1 Supply finish hardware to those who are to install it, complete with templates and other complete installation instructions in sufficient time to avoid delaying the progress of the work.
 - .2 Supply complete templates and instructions to all door and frame manufacturers for factory machining of products to receive Hardware.

1.9 INSPECTION

- .1 Hardware Distributor must perform the following inspections:
 - .1 Check all hardware when it has been installed and notify the Consultant of improper installation, defective materials, or products installed that were not specified. Replace defective hardware promptly.
 - .2 Check all door closers after they have been installed to make sure that all adjustments such as back-checking degree have been properly made. Notify the Consultant of any closers which have not been properly adjusted.

1.10 MAINTENANCE

Maintenance Service
 Following occupancy of the building by the Owner, arrange with the Owner's maintenance staff for instruction of proper use, servicing, adjusting and lubrication of all finish hardware. Submit to the Consultant a list of attendees and meeting date.

1.11 EXTENDED WARRANTIES

- .1 Provide the following manufacturer's warranties beyond the date of expiration of the Contract warranty:
 - .1 Mortise Hinges Lifetime
 - .2 Pivot Sets 2 yrs.
 - .3 Locks 7 yrs.
 - .4 Keypad Locks 1 yr.
 - .5 Exit Devices 3 yrs.
 - .6 Door closers -mechanical 10 yrs.
 - .7 Door Hold open Devices - Electro mechanical 2 yrs.
 - .8 Overhead stops/holders 1 yr.
 - .9 Floor/Wall stops 1 yr.
 - .10 Electric Strikes/Key Switches/Power Supplies 1 yr.
 - .11 Electromagnetic Locks Lifetime
 - .12 All other hardware items 1 yr.

2 PRODUCTS

2.1 MATERIALS

- .1 Fabricate all hardware to template. Provide templates and template hardware together with the instructions necessary for door and frame preparation.

- .2 Supply all hardware with necessary screws, bolts or other fastening devices to anchor hardware in position neatly and properly in accordance with best practices.
- .3 Only products listed in the hardware schedule or the approved alternates noted in the following list are to be used on this project.
- .4 Use one manufacturer's products only for all similar items.
- .5 All exterior doors shall be fitted with complete perimeter weatherstripping and threshold where not provided by door or frame manufacturer.
- .6 All exterior aluminum doors shall be fitted with recessed retractable, bottom sweeps.
- .7 No substitutions are allowed for the following products, due to integration with existing hardware:
 - .1 Locksets, Latchsets, and Privacy Sets.
 - .2 Panic Sets
 - .3 Door Closers.

2.2 FASTENINGS

- .1 Supply all required bolts, screws, expansion shields, anchors, and other related accessories for satisfactory attaching or installing of all finish hardware.
- .2 Exposed fasteners shall match finish of, and be of compatible material with hardware.
- .3 Where push/pull hardware is scheduled, door pull must be through-fastened and have fasteners concealed by push plate on opposite side.

2.3 HINGES

- .1 Butt Hinges: ANSI/BHMA-A156.1, Grade 1.
 - .1 Supply hinges with non-removable pin (NRP) option on all doors where the hinge barrel is exposed on the secured exterior side of the door.
 - .2 Use two hinges on doors up to 1525mm and an additional hinge for each additional 760mm or fraction thereof.
 - .3 Doors 900mm wide and less; 114mm high hinges; doors greater than 914mm wide; 127mm high hinges, all heavystandard weight.

- .4 Provide Model FBB199-32D for all exterior applications; Model FBB168-26D for heavy use and oversized doors; Model FBB179-26D for all other interior doors as indicated in the Hardware Schedule.

2.4 BOLTS

- .1 Surface/Flush Bolts: ANSI/BHMA-A156.16, Grade 1.
 - .1 Surface Bolts
 - .1 Surface bolts to have 25mm throw with vandal-resistant concealed mounting. Units to be constructed of heavy duty steel and be cUL listed up to three (3) hours when used on the inactive door of a pair up to 2440mm in height.
 - .2 Manual Flush Bolts-Metal Doors
 - .1 Manual flush bolt for metal doors to be cUL listed for 3-hour fire doors with 13mm diameter bolt tip, 19mm throw. Rod length to be 305mm. Supply dustproof strikes with all flushbolts.

2.5 LOCKSETS, LATCHSETS, DEADLOCKS

- .1 Grade 2 Cylindrical-Lever
 - .1 ANSI/BHMA-A156.2, Grade 2 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. 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.
- .2 Grade 1 Deadbolt
 - .1 ANSI/BHMA-A156.5, Grade 1 deadbolt supplied with solid brass or bronze trim rings and 25mm throw high-strength, steel alloy deadbolt with hardened steel roller resistant to sawing and kick-in attacks. Metal shield protects bolt from attack through the door as well as hardened steel balls that protect mounting screws from drill attack. Exclusive wood frame reinforcer protects wood jamb against kick-in attacks.

2.6 EXIT DEVICES

- .1 Heavy Duty: ANSI/BHMA-A156.3, Grade 1 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 914mm wide supply long bar exit devices, doors 2134mm high and greater supply extension rods. 1,000,000cycle testing independently certified by ETL.

.2 Device Trim

.1 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.

.3 Mullions Non-Rated

.1 Steel mullion prepared for two strikes for use with all rim devices and key removable kit to provide quick removal to provide single door performance and security on double door applications.

.4 Mullions Rated

.1 Fire rated cUL approved mullion for up to three hour openings up to 2.4m x 2.4m using rim devices prepared for strikes. Supply with key removable kit to provide quick removal to provide single door performance and security on double door applications.

.5 Exit devices installed on exterior doors must have dead latching bolts to ensure tamper proof security.

2.7 DOOR CLOSERS

.1 Door closers to be Grade 1 ANSI/BMHA A156, and have the following features (see separate closer sections below for further information):

.1 fully hydraulic, rack and pinion action with high strength cast iron cylinders and one piece forged steel pistons.

.2 hydraulic fluid of a type requires no seasonal adjustments, and has constant temperature control from 49°C to -35°C.

.3 hydraulic regulation controlled by tamper-proof, non-critical screw valves, adjustable with a hex wrench.

.4 separate adjustments for backcheck, general speed and latch speed.

.5 include high efficiency, low friction pinion bearings.

.6 size 1 manual door closers to provide less than 22N opening force on a 914mm door leaf.

- .7 closers with painted finishes shall exceed a minimum 100-hour salt spray test, as described in ANSI/BHMA-A156 and ASTM B117.
- .8 closers detailed with plated finishes shall include plated covers (or finish plates) , arms and visible fasteners.
- .9 provided with all mounting plates required to mount on any special door and frame conditions.

2.8 DOOR OPERATORS

- .1 Heavy Duty Electric Operator (Push Side Mount)
 - .1 ANSI/BHMA-A156.19, non-sized (2-5) and non-handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft. With forged steel main arm. Power operator to include:
 - .1 Provisions for separate conduits to carry high and low voltage wiring in compliance with the National Electrical code.
 - .2 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.
 - .3 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.
 - .4 Soft Start Motor Control: required for controlled start once actuator is depressed to extend the service life of all drives components.
 - .5 Built in Power Supply to deliver 12V and 24V outputs up to a maximum of 1.0 amp.
 - .6 Certified by cUL for use on labeled doors.
 - .7 Independent adjustments for all electrically controlled functions within controller module.
 - .2 Actuators
 - .1 Wall Type
 - .1 Wall plate switch must be hard-wired either 12V DC or 24V DC actuator with round, stainless steel touch plate in either 114mm or 152mm diameters. 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.

- .3 Low energy door operators will be supplied and installed by factory trained installers. Hardware supplier will coordinate the installation of the door operators and include the cost of labour for this work.

2.9 OVERHEAD DOOR STOPS/HOLDERS

- .1 Heavy Duty Surface Mounted
 - .1 ANSI/BHMA-A156.8, Grade 1. Surface overhead stops/holders shall be 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.
- .2 Heavy Duty Concealed Mounting
 - .1 ANSI/BHMA-A156.8, Grade 1. Concealed overhead stops/holders shall be non-handed for single or double-acting doors with a low profile channel, constructed of heavy gauge brass material, is mortised in the door and jamb bracket is mortised in the doorframe. This allows for the unit to be fully concealed when door is in the closed position. Units to be field adjustable for function changes if required.

2.10 PULLS AND PLATES

- .1 Supply door trim as listed in hardware schedule. Supply pulls with back to back (BTB) or through bolt mounting as required. When push plates are listed with door pulls, install the push plate to conceal the through bolt.
- .2 All kickplates, push plates, and bumper plates must have all sides beveled and corners rounded to ensure no sharp edges. Supply plates with countersunk screw holes.
- .3 Kick plates will be minimum 0.050mm thick unless listed otherwise; size to be door width less 35mm for single door, and less 25mm for pairs of doors. Heights as scheduled.

2.11 DOOR STOPS AND HOLDERS

- .1 Floor Stops (Doors without Threshold)
 - .1 ANSI/BHMA-A156.6. Floor stops to be 25mm overall height with 4.8mm base height for use on doors without thresholds. Heavy-duty cast dome stop constructed of brass/bronze with gray, non-marring rubber bumper.
- .2 Floor Stops (Doors with threshold or undercut doors)

- .1 ANSI/BHMA-A156.6. Floor stops to be 25mm overall height with 14.3mm base height for use on doors with thresholds or undercut doors. Heavy-duty cast dome stop constructed of brass/bronze with gray, non-marring rubber bumper.
- .3 Wall Stops (No Button on Locking Hardware)
 - .1 ANSI/BHMA-A156.6. Wall stops to be constructed of heavy-duty brass base with special retainer cup that makes the rubber stop tamper resistant. Convex design of rubber bumper.
- .4 Wall Stops (Projecting Button on Locking Hardware)
 - .1 ANSI/BHMA-A156.6. Wall stops to be constructed of heavy-duty brass base with special retainer cup that makes the rubber stop tamper resistant. Concave rubber bumper to avoid damage to locks with projecting buttons.
- .5 Supply wall stops where wall conditions are sufficient to support impact loads, such as stud partitions with wood blocking, masonry, or concrete. Supply floor stops with sufficient height to suite the floor condition or undercut of doors.
- .6 Overhead stops and mechanical holders shall be surface mounted unless a conflict exists with door closers or other hardware. Provide door stays with friction action in locations that do not have door closers. Install all overhead stops and holders for 90° stop unless otherwise specified.
- .7 Electronic door holders will be supplied tri-voltage and be connected to the fire alarm system by Division 16 to release the door when signaled.

2.12 DOOR SEALS

- .1 Supply perimeter seals to fully cover all gaps between door, frame, and floor condition to seal against weather, sound, or smoke as required and scheduled.
- .2 Frame gaskets shall be closed cell neoprene. Extruded housing must have a rib to prevent distortion during installation. Aluminum frames will be provided with weather stripping inserts by the frame supplier.
- .3 Door bottoms will be heavy-duty and have an adjustment screw to ensure proper contact with flooring. Supply correct drop insert for carpet where required.

2.13 THRESHOLDS

- .1 Supply extruded aluminum thresholds to ensure the sweep or door bottom makes full contact. Supply thermally broken thresholds for all exterior door openings.
- .2 Threshold height shall not exceed 13mm for barrier-free path of travel.

2.14 ELECTRONIC HARDWARE

- .1 Keyswitch
 - .1 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.
- .2 Electric Strikes
 - .1 ANSI/BHMA-A156.31, 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 19mm 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.
- .3 Magnetic Locks
 - .1 ANSI/BHMA-A156.23, Grade 1. Electromagnetic locks to be field selectable dual voltage 12/24VDC with a minimum holding force of 7,339N, residual magnetism within one second of 17.8N maximum and inductive kickback not to exceed 53 volts peak. Electromagnetic locks to be powered by filtered and regulated power supply. Electromagnetic locks used on labeled fire door assemblies shall be cUL listed as auxiliary locks, rated for A-label openings. Housings shall not project more than 45mm into the door opening. Electromagnetic locks to be furnished with an adjustable mounting bracket for accurate installation and furnished with an integral circuit board with terminal strip for accurate wiring.
- .4 Power Supplies
 - .1 Power supplies to be Underwriter Laboratories (UL) listed for general-purpose use tested to meet UL1012 specifications. Power supplies to have 12/24V DC field selectable output voltage with output current of 3 amps at 12V DC and 2 amps at 24V DC with supply output voltage filtered and regulated. The power supply to be inherently modular by design for ease of installation and to provide flexibility for future system modifications when necessary.

- .5 Include power supplies that are compatible with magnetic lock and have a NFPA-101 fire alarm release. Reset key switch will be centrally located and will re-arm all the magnetic locks in the building.
- .6 Request to exit switches at all required fire exits will be frame-mounted, located on the push side for staff use and will include an adjustable time delay module.
- .7 Access control will be frame-mounted stand-alone keypad complete with adjustable time delay. Units will have all functions keypad programmable, 12 or 24 volt AC/DC with a code length of 3-6 digits.
- .8 Electronic hardware will be supplied and installed by this section, including all low voltage device wiring.

2.15 FINISHES

- .1 Finishes are specified as follows:

Item	BHMA#	Finish Description	Base Material(s)
Hinges	630	satin stainless steel	stainless steel
Hinges	626	satin chrome plated	brass/bronze
Hinges	652	satin chrome plated	steel
Pivots	689	powder coat aluminum	steel
Lock Trim	626	satin chrome plated	brass/bronze
Exit Devices	626	satin chrome plated	brass/bronze
Dr Closer	689	powder coat aluminum	steel
Dr Pulls	630	satin stainless steel	stainless steel
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			
Coat hooks	626	satin chrome plated	brass/bronze
Mullions	628	anodized aluminum	steel
Key Switches	630	satin stainless steel	stainless steel
Electric Strikes	630	satin stainless steel	stainless steel
Magnetic Locks	628	anodized aluminum	steel

2.16 KEYING

- .1 General

- .1 Architectural Hardware Consultant (AHC) will meet with the Owner to obtain and finalize all keying requirements, and will subsequently issue copies of the keying schedule for review.
 - .2 Key Material: Provide manufacturer's standard embossed keys of nickel silver to ensure durability.
 - .3 Key Quantity: Furnish keys in the following quantities:
 - .1 Grand Master keys per grand master group: 6 each.
 - .2 Master keys per master group: 6 each.
 - .3 Change keys per cylinder or keyed alike group: 4 each.
 - .4 Deliver all permanent key blanks and security keys direct to Owner 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.
 - .5 If required by the Owner, furnish one key control system complete with indexed door numbers, key codes, bittings, building numbers, room numbers, lock function, design, and finish. In addition, include model numbers, handing, design, and functions of exit devices and door closers. Transmit to the Owner by secure carrier, return receipt requested.
 - .6 Provide complete cross-index system, place keys on markers and hooks in the cabinet as determined by the final key schedule. Provide one each key cabinet and hinged panel type cabinet for wall mounting as noted in detailed hardware schedule.
- .2 Standard Keying With High-Security Cylinders
 - .1 Permanent keying will be Medeco as required by the Owner.

3 EXECUTION

3.1 EXAMINATION

- .1 Ensure that doors and frames are properly prepared and reinforced to receive finish hardware prior to installation.
- .2 Ensure that door frames and finished floor are sufficiently plumb and level to permit proper engagement and operation of hardware.

- .3 Submit to Consultant in writing a list of deficiencies determined as part of inspection required in 3.3.1 and 3.3.2, prior to installation of finished hardware.

3.2 INSTALLATION

- .1 Install hardware to ANSI/DHI-A115.1G.
- .2 Install hardware at mounting heights as specified in the manufacturers templates or specific references in approved hardware schedule or approved elevation drawings. Where mounting height is not otherwise specified herein, install hardware at the following mounting heights:
 - .1 Locksets: 1015mm.
 - .2 Exit device: 1015mm.
 - .3 Push/Pull: 1065mm.
 - .4 Deadlock: 1200mm.
- .3 Install hardware using only manufacturer supplied and approved fasteners in strict adherence with manufacturers published installation instructions.
- .4 Ensure that all locksets / latchsets / deadlocks are of the correct hand before installation to ensure that the cylinder is in the correct position. Handing is part of installation procedure.
- .5 Ensure that all exit devices are of the correct hand and adjust device cam for proper outside trim function prior to installation. Handing is part of installation procedure.
- .6 Follow all manufactures installation instructions. Adjustment is inclusive of spring power, closing speed, latching speed and back-check at the time of installation.
- .7 Delayed action door closers are to be adjusted to forty (40) second delay for handicapped accessibility and movement of materials. Time period to be approved by Owner.
- .8 Install head seal prior to installation of parallel arm mounted door closers and push side mounted door stops/holders.
- .9 Counter sink through bolt of door pull under push plate during installation.
- .10 Mount all closers, automatic operators and hold-open devices with through bolts, as indicated in the finish hardware schedule.
- .11 Where door stop contacts door pulls, mount stop to strike bottom of pull.

- .12 Remove construction locks when directed by Consultant; install permanent cores and check operation of all locks.
- .13 Other trades installing hardware must follow all manufacturers instructions including door closer adjustment, handing of locksets as required, and degree of door swing.
- .14 Hardware Distributor will include all labour to terminate secondary low voltage wire runs at all door control devices supplied by this section, including but not limited to; door operators, magnetic locks, push button code entry units (keypads), request to exit switches, electric strikes and any associated electrical equipment. Ensure system is tested and complete for Owner's use. Provide staff training for push button code system (keypads) including all programming function and maintenance.
- .15 Hardware Distributor will instruct the installer as to how various newer or unusual items that are required to be installed for proper performance.

3.4 FIELD QUALITY CONTROL

- .1 Perform bi-monthly on-site inspections during hardware installation and provide inspection reports listing progress of work, unacceptable work and corrective measures. Repair or replace as directed by the Consultant.
- .2 Upon completion of hardware installation, arrange with the Owner to instruct the Owner's personnel in the proper operation, adjustment, and maintenance of all finish hardware supplied under this Contract.
- .3 Before completion of the Work but after finish hardware installation has been completed, submit a certificate to the Consultant stating that final inspection has been made and that all hardware has been checked for installation and operation by representatives of both the Hardware Supplier and the Hardware Distributor, and that operation and maintenance of all hardware have been fully demonstrated to the satisfaction of the Owner's personnel.

3.5 ADJUSTING AND CLEANING

- .1 Check and make final adjustments to each operating item of hardware on each door to ensure proper operation and function.
 - .1 All hardware to be left clean and free of disfigurements.
 - .2 Check all locked doors against approved keying schedule.

3.6 PROTECTION

- .1 Protect hardware from damage during construction period by removing and reinstalling or where necessary, using temporary hardware to maintain finish in new condition and maintain manufacturers warranty.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide automatic power door operator systems including the following:
 - .1 Operator equipment
 - .2 Control system
 - .3 Activation devices

1.3 REFERENCE STANDARDS

- .1 Aluminum Association (AA); DAF-45, Designation System for Aluminum Finishes.
- .2 American Architectural Manufacturers Association (AAMA); Aluminum Curtain Wall Design Guide Manual.
- .3 ASTM B209; Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .4 CSA-G40.21; Structural Quality Steels
- .5 CAN/CSA G164; Hot Dip Galvanizing of Irregularly Shaped Articles.
- .6 CAN3-S157; Strength Design in Aluminum.
- .7 CSA W59.2; Welded Aluminum Construction.
- .8 CAN/CGSB-69.26-96/ANSI/BHMA A156.10; Power-Operated Pedestrian Doors.
- .9 CAN/CGSB-69.35-M89/ANSI/BHMA A156.19; Power Assist and Low Energy Power-Operated Doors.
- .10 CAN/ULC-S533; Egress Door Securing and Releasing Devices.

1.4 SYSTEM DESCRIPTION

- .1 Designed for low energy applications, surface mounted, automatic swing door operator consists of aluminum operator housing, A.C. electro-hydraulic motor, operator assembly, wiring harnesses, swing arm and electronic control.
- .2 Power Open: Automatic door operator powers the door open by forces transmitted hydraulically to the drive shaft and maintains a constant engagement throughout the opening cycle. Both opening and closing speed are field adjusted per current ANSI 156.19. Automatic door system is self-contained, requiring no remote pumps, exterior piping or compressors. The operator shall be equipped with a hydraulic bypass (relief valve), to divert fluid back to a reservoir to prevent motor overload if the door is restricted during opening cycle. Automatic door system functions as a manual door closer in the event of a power failure. Manual opening force is unaffected by opening speed adjustment. Manual force to open the door will not exceed 15 pounds, measured 25mm in from latch edge of door.
- .3 Spring Close: The automatic door operator is spring closed. The spring is non-handed and returns the door to full close.

1.5 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 30 00.
 - .2 Indicate on shop drawings, layout, dimensions, elevations, detail sections of members, materials, finishes, hardware including mounting heights, anchors and reinforcement, provisions for expansion, and other pertinent information.
- .2 Maintenance Data
 - .1 Provide complete operation and maintenance data for inclusion in Operations and Maintenance Manual. Include spare parts list.
 - .2 Include manufacturer's parts lists, servicing frequencies, instructions for adjustment and operation applicable to each component.
 - .3 Include name, address and telephone number of nearest authorized service representative.

1.6 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
- .2 Installation/Application

- .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - .1 Deliver materials to site protected from damage.
 - .2 Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
 - .3 Protect materials and finish from damage during handling and installation.
- 1.8 MAINTENANCE SERVICE
 - .1 Manufacturer shall provide central-dispatch maintenance service available 24 hours per day, 365 days per year for maintenance service during the Contract Warranty period.
 - .2 Toll free phone number shall be prominently displayed on header of each operator.
- 2 PRODUCTS**
- 2.1 MANUFACTURERS
 - .1 The following products and manufacturers are acceptable:
 - .1 Series 7000, by Horton Automatics (Niagara Automatic Entrances Inc.),
 - .2 PowerSwing, by Besam Automated Entrance Systems Inc. (Axis Door Products).
- 2.2 MATERIALS
 - .1 Aluminum: Extrusions of minimum 3mm thick, Alcan 6061-T6 alloy for structural members, 6063-T5 for non-structural members.
 - .2 Screws, bolts and fasteners: where used with aluminum shall be of 300 series stainless steel or 400 series stainless steel cadmium plated.

- .3 Steel Reinforcement: to CAN/CSA-G40.21, grade 300W.

2.3 AUTOMATIC SWING DOOR OPERATOR

- .1 Operator: Electro-hydraulic type, self-contained operator, powered by a 1/6 HP motor. Operator is non-handed. The operator housing provides a seal against dust, dirt and moisture.
- .2 Electronic Control: A self-contained, solid-state integrated circuit controls the operation and switching of the swing power operator. The electronic control provides low voltage power supply for all means of actuation. No external or auxiliary low voltage power source will be allowed. The controls include time delay (5 to 30 seconds) for normal cycle.
- .3 Connecting Hardware: Surface-mounted operator is connected to the door by means of a steel door arm. Door arm is secured to the top rail of the swing door using one piece threaded tubular inserts for aluminum doors, 1/4-20 binding head and post screws (sex bolts) for wood and hollow metal doors. Knurled door arm adaptor is broached for positive engagement with shaft.
- .4 Activation
 - .1 Wall Switches: Recessed push-button wall switches, with steel back-boxes and stainless steel push buttons engraved with standard barrier-free logo.
 - .2 Bollard Switches: 152mm square aluminum bollard access post 1067mm high, with recessed switch, and square stainless steel push plate engraved with standard barrier-free logo. Mod# 916-655-C 42x6 Square Bollard with 635-318 Actuator, by CareProdX, Fishers IN.
 - .3 Provide activation devices where indicated on the drawings and in the door and frame schedule.

2.4 ELECTRICAL CHARACTERISTICS

- .1 Nominal current draw 222 watts (1.85 amps at 120V AC). Motor shall draw 672 watts maximum. Electric motor shall be equipped with a built-in thermal overload protection, and shall not exceed 10 amps current draw.
- .2 Provide two low-voltage 18 gauge stranded wires (per operator) from each automatic operator to remote activation devices.

2.5 FINISHES

- .1 Anodized: Class 1 anodic colour coating to AA-M12C22A42/44; #29 Black.

2.6 FABRICATION

- .1 Fabricate units square and true with maximum tolerance of plus or minus 1.5mm for units with a diagonal measurement of 1800mm or less and plus or minus 3mm for units with a diagonal measurement over 1800mm.

- .2 Provide all internal reinforcing as required for the proper structural design and support of the framing system.
- .3 All joints shall be accurately machined, and assembled to provide neat joints.

3 EXECUTION

3.1 INSTALLATION

- .1 Install power door operators in accordance with reviewed shop drawings and manufacturer's printed instructions, including controls, wiring, and all activation devices.
- .2 Coordinate installation of components with related and adjacent work.
- .3 Set work plumb, square, level, free from warp, twist and superimposed loads.
- .4 Securely anchor work in required position.
- .5 Apply isolation coating to separate aluminum and primed or galvanized steel surfaces at points of contact with cementitious materials.

3.2 SEALANT APPLICATION

- .1 Comply with requirements of Section 07900 for sealants, fillers and gaskets to be installed during installation of doors and frames.
- .2 Conceal sealant within aluminum work except where exposed use is permitted by Construction Manager.
- .3 Set sill members in bed of sealant.

3.3 ADJUSTING

- .1 After repeated operation of completed installation equivalent to three days of use by normal traffic (100 to 300 cycles), readjust door operators and controls for optimum, smooth operating condition and safety and for weather tight closure. Lubricate hardware, operating equipment and other moving parts.
- .2 Adjust doors to provide tight fit at contact points with enclosure.

3.4 PROTECTION OF FINISHED WORK

- .1 Protect finished installation until time of final cleaning and inspection.
- .2 Leave all factory installed protective films in place until time of final cleaning.

3.5 FINAL CLEANING

- .1 Clean aluminum surfaces promptly after installation. Exercise care to avoid damage to coatings.
- .2 Remove protective material from prefinished aluminum surfaces.

- .3 Wash exposed surfaces with mild solution of detergent and warm water, using soft, clean wiping cloths. Remove dirt from corners. Wipe surfaces clean.
 - .4 Remove excess sealant by moderate use of solvent, of type acceptable to sealant manufacturer.
- 3.6 DEMONSTRATION
- .1 Demonstrate operation, operating components, adjustment features, and lubrication requirements to Owner.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide glass and glazing for:
 - .1 Interior doors and screens,
 - .2 Exterior doors, and screens,
 - .3 Exterior windows,
 - .4 Exterior curtain wall systems,
 - .5 Unframed mirror glazing.
- .2 Section includes but is not limited to the provision of:
 - .1 Glass
 - .2 Specialty glazing products
 - .3 Glazing sealants, gaskets, tapes, and backing materials
 - .4 Miscellaneous glazing materials necessary to complete the work of this section

1.3 REFERENCE STANDARDS

- .1 ANSI/ASTM E330; Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
- .2 ASTM C509; Standard Specification for Elastomeric Cellular Gasket and Sealing Material.
- .3 ASTM C542; Specification for Lock-Strip Gaskets.
- .4 ASTM C864; Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
- .5 ASTM C920; Specification for Elastomeric Joint Sealants.
- .6 ASTM C1115; Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.

- .7 ASTM D790; Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - .8 ASTM D2240; Test Method for Rubber Property - Durometer Hardness.
 - .9 ASTM E84; Test Method for Surface Burning Characteristics of Building Materials.
 - .10 ASTM F1233; Test Method for Security Glazing Materials and Systems.
 - .11 CAN/CGSB-12.1; Tempered or Laminated Safety Glass.
 - .12 CAN/CGSB-12.3; Flat, Clear Float Glass.
 - .13 CAN/CGSB-12.5; Mirrors, Silvered.
 - .14 CAN/CGSB-12.8; Insulating Glass Units.
 - .15 CAN/CGSB-12.9; Spandrel Glass.
 - .16 CAN/CGSB-12.20; Structural Design of Glass for Buildings.
 - .17 Flat Glass Manufacturers Association (FGMA) Glazing Manual.
 - .18 Laminators Safety Glass Association Standards Manual.
- 1.4 PERFORMANCE REQUIREMENT
- .1 Provide continuity of building enclosure vapour and air barrier using glass and glazing material as follows:
 - .1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.
 - .2 Size glass to withstand wind loads, dead loads and positive and negative live loads acting normal to plane of glass to a design pressure measured in accordance with the Ontario Building Code and CAN/CGSB-12.20.
 - .3 Limit glass deflection to flexural limit of glass with full recovery of glazing materials.
 - .4 Provide thermal stress analysis for all single glazed lites and all sealed glass units. Make recommendations for additional heat treatment, thickness change, or other required modifications prior to ordering of materials or manufacture of sealed glass units.
- 1.5 SAMPLES
- .1 Submit 300mm x 300mm samples of all tinted, coated, and surface treated glass in accordance with Section 01 30 00.
- 1.6 QUALITY ASSURANCE
- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified

herein, warranty requirements, and in accordance with generally accepted, industry best practices.

- .3 Documentation
 - .1 If requested, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

1.7 ENVIRONMENTAL REQUIREMENTS

- .1 Install glazing when ambient temperature is 10°C minimum. Maintain ventilated environment for 24 hours after application.
- .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.8 MAINTENANCE DATA

- .1 Provide maintenance data including cleaning instructions for incorporation into Operations and Maintenance manual.

1.9 EXTENDED WARRANTY

- .1 Provide sealed glass unit manufacturer's warranty certificate stating that the factory-sealed insulating glass units specified under this section are guaranteed against failure of seal of enclosed air space and deposits on inner faces of glass detrimental to vision, for a period of ten (10) years from the Date of Substantial Performance.

2 PRODUCTS

2.1 FLAT GLASS

- .1 Safety Glass
 - .1 Tempered (TG): to CAN/CGSB-12.1, tong-free, roller marks free, with visible after installation factory-applied permanent impression in one corner identifying each pane as tempered. Glass must have smooth ground edges where used in Draft Stop applications. Thickness as indicated in schedules and on drawings.
 - .2 Laminated (LG): to UL 972, constructed of 2 layers of heat-strengthened glass, with 1.5mm Saflex® PVB interlayer, CPSC Category II.

- .2 Low Emissivity (Low-E) Glass, minimum 6mm thick, PPG "Solarban 70XL Clear" by PPG Industries Inc.;
 - .1 Coating: soft-sputtered.
 - .2 Visible Light Transmittance: 64%.
 - .3 Shading co-efficient: 0.44.
 - .4 Visible Light Reflectance: 11%.
 - .5 Tempered Low-E Glass; to CAN/CGSB-12.1, 6mm thick, tong free, roller marks free, with visible after installation factory-applied permanent impression in one corner identifying each pane as tempered. Low-E coating one face.

- .3 Spandrel Glass: to CAN/CGSB-12.9, PPG Starfire Glass with Opacicoat coating on Surface #4, Charcoal colour as selected by Consultant, minimum 6mm thick.
 - .1 Type: 1 – Tempered safety glass.
 - .2 Class: A - Float
 - .3 Style: 3 - Organic coated.
 - .4 Form: M - Monolithic.

- .4 Mirror Glass: Silvered mirror glass to CAN/CGSB-12.5.
 - .1 Large Sized and Full Width Mirrors: 6mm thick, tempered safety glass, back finished with one coat silver, one coat copper, and two coats backing paint. Mirrors to be adhesive mounted to wall. Refer to drawings for sizes.

- .5 Fire Resistive Glass (FG): laminated fire-resistive glass with surface-applied film; FireLite®NT, as manufactured by Nippon Electric Glass Company, Ltd., distributed by Technical Glass Products, Kirkland WA, or KERALITE as manufactured by Vetrotech Saint-Gobain Auburn WA (distributed by F1 Glass Solutions, Toronto);
 - .1 Properties:
 - .1 Thickness: 8mm overall.
 - .2 Weight: 2.4 lbs./sq. ft.
 - .3 Approximate Visible Transmission: 88 percent.
 - .4 Approximate Visible Reflection: 9 percent.
 - .5 Fire-rating: 20 minutes to 3 hours for doors; 20 minutes to 90 minutes for other applications.
 - .6 Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
 - .7 STC Rating: Approximately 35 dB.
 - .8 Surface Finish: Premium (polished).
 - .9 Positive Pressure Test: UL 10C, UBC 7-2 and 7-4; passes.
 - .10 Labelling: Permanently label each piece of FireLite®NT with the FireLite® logo, UL logo and fire rating in sizes up to 3,325 sq. in., and with the FireLite label only for sizes that exceed the listing (as approved by the local authority having jurisdiction).
 - .11 Fire Rating: Fire rating listed and labelled by ULC for fire rating scheduled at opening locations on drawings, when

tested in accordance with ULC Standards CAN4 S-104 and CAN4 S-106.

- .6 Sealed Insulating Glass Units: to CAN2-12.8 and composed of two lites of minimum 6 mm thick glass separated by a 13mm wide "warm edge" spacer, double sealed and atmospheric pressure equalized to prevent bowing of the glass lites in the vertical position. All units shall be Argon Gas filled. Edges of glass shall be straight cut, free of nicks and other imperfections conducive to breakage. 25mm overall thickness for double glazed units. U-Value of 0.24, and SHGC of 0.27 for sealed glass units.
 - .1 Vision Units (GL1): Double-glazed, double sealed insulating glass units, clear tempered glass outer lite, and tempered inner lite. with specified low emissivity coating on No. 3 surface.
 - .2 Vision Units (GL2): Double-glazed, double sealed insulating glass units, clear laminated glass inner lite, and tempered clear safety glass outer lite, with specified low emissivity coating on No. 2 surface.
- .7 Patterned Glass:
 - .1 Surface Treatment: Satin acid-etched surface treatment on Surface #1. AviProtek by Walker Glass, or equivalent.
 - .2 Glass Surface Pattern
 - .1 Colour: White.
 - .2 Pattern: 4"x4" 5mm dots, bird-friendly pattern as detailed on the drawings, applied to Surface #1 of exterior glazing units.

2.2 GLAZING FILMS

- .1 Film Coatings for glass, 75 micron thick semi-transparent film, self-adhesive; 3M Fasara SH2FGCL Cloud.

2.3 GLAZING MATERIALS

- .1 Setting Blocks: EPDM or Neoprene, 80 – 90 (Shore A) durometer hardness to ASTM D2240, to suit glazing method, glass weight, and area.
- .2 Spacer Shims: EPDM or Neoprene, 50 – 60 (Shore A) durometer hardness to ASTM D2240, 75mm long x one half height of glazing stop x thickness to suit application. Self adhesive on one face.
- .3 Glazing Tapes
 - .1 Compression: 100% solids, preformed macro-polyisobutylene/butyl rubber with integral synthetic rubber spacing rod; coiled on release paper; size as required for frame stop heights; POLYSHIM II, by Tremco.
 - .2 Non-compression: 100% solids, preformed butyl rubber to ASTM C1281, 66 (Shore 00) durometer hardness to ASTM D2240; coiled on release paper; size as required for frame stop heights; Tremco 440 tape.

- .3 Fire Rated Glass Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent.
- .4 Glazing Gaskets
 - .1 Dense Gaskets for Compression Glazing
 - .1 Extruded from ozone-resistant compound, resistant to sunlight, weathering, oxidation and permanent deformation under load. Gasket Configuration shall provide for mechanical engagement with the metal. Gaskets shall meet either ASTM C-864 Option II, or ASTM C-1115 Type C (for silicone compounds).
 - .1 Dense Neoprene extrusions: Tremco Incorporated, 50, 60 and 70 durometer hardness.
 - .2 Dense EPDM extrusions: Tremco Incorporated, 40, 50, 60 and 70 durometer hardness.
 - .3 Dense SCR-900 extrusions: Tremco Incorporated, 60 and 70 durometer hardness.
 - .4 Dense Silicone extrusions: Tremco Incorporated, 40, 60 and 70 durometer hardness.
 - .2 Cellular Gaskets for Compression Glazing:
 - .1 Extruded from ozone-resistant compound, resistant to sunlight, weathering, oxidation and permanent deformation under load. Gasket configuration shall provide for mechanical engagement with the metal. Gaskets shall meet ASTM C-509 Option II.
 - .1 Cellular extrusions: Tremco Incorporated, Closed Cell Neoprene extrusions.
 - .2 Cellular extrusions: Tremco Incorporated, Closed Cell EPDM extrusions.
- .5 Glazing Sealants
 - .1 Cap Beads
 - .1 Commercial Glazing: single or multi-component, non-acid curing silicone sealant to ASTM C920;
 - .1 One part neutral cure silicone; equivalent to Spectrem 2, by Tremco.
 - .2 Heel and Toe Beads
 - .1 Commercial Glazing: single or multi-component, non-acid curing silicone sealant to ASTM C920;
 - .1 One part medium modulus silicone sealant; equivalent to Tremsil 600, by Tremco.
 - .3 Perimeter Seals
 - .1 Single or multi-component, elastomeric sealant to ASTM C920;
 - .1 One part neutral cure silicone; equivalent to Spectrem 2, by Tremco.

- .2 One part low modulus neutral cure silicone; equivalent to Spectrem 3, by Tremco.
 - .4 Metal Expansion Seals
 - .1 Single or multi-component, non-acid curing silicone sealant to ASTM C920;
 - .1 One part, neutral curing, silicone sealant; equivalent to Spectrem 2, by Tremco.
 - .5 Metal to Metal Joinery Seals
 - .1 Single or multi-component, non-acid curing silicone sealant to ASTM C920;
 - .1 One part medium modulus silicone sealant; equivalent to Tremsil 600, by Tremco.
 - .6 Concealed Splice Sleeve Conditions
 - .1 Single component, non-drying, non-skinning synthetic rubber sealant;
 - .1 One part synthetic rubber; equivalent to Tremco Curtain Wall Sealant, by Tremco.
 - .7 Fire Rated Glass Sealant: One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable. Acceptable Products:
 - .1 Dow Corning 795 - Dow Corning Corp.
 - .2 Silglaze-II 2800 - General Electric Co.
 - .3 Spectrem 2 - Tremco Inc.
- 2.4 GLAZING ACCESSORIES
- .1 Glazing Clips: manufacturer's standard type.
 - .2 Mirror Attachment: Stainless steel continuous J-molds.
- 2.5 SEALED GLASS UNIT FABRICATION
- .1 Fabricate sealed glass units through the Insulating Glass Manufacturers Association of Canada Certification Program to CAN/CGSB 12.8. Sealed units shall bear IGMAC Certified Products List number and be properly identified.
- 3 EXECUTION**
- 3.1 EXAMINATION
- .1 Verify that openings for glazing are correctly sized and within tolerance.
 - .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
- 3.2 PREPARATION

- .1 Clean contact surfaces with solvent recommended for use by the sealant manufacturer, and wipe dry thoroughly.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

3.3 EXTERIOR GLAZING

- .1 Aluminum Frames - Tape / Gaskets
 - .1 Cut glazing tape to length and set against permanent stops, level with sight line. Seal corners by butting tape and dabbing with sealant.
 - .2 Apply heel bead of sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapour seal.
 - .3 Place setting blocks at 1/4 points, with edge block maximum 150mm from corners.
 - .4 Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of light or glass unit.
 - .5 Install removable stops with gaskets inserted between glazing and applied stops.

3.4 INTERIOR GLAZING

- .1 Wet Method - Sealant / Sealant
 - .1 Install glazing resting on setting blocks. Install applied stop and centre light by use of spacer shims at 600mm centres, 6mm below sight line.
 - .2 Locate and secure glazing light using spring wire clips or glazers' clips.
 - .3 Fill gaps between glazing and stops with glazing sealant until flush with sight line. Tool surface to straight line.
- .2 Steel Frames - Tape / Sealant
 - .1 Cut glazing tape to length and set against permanent stops, 3mm below sight line. Seal corners by butting tape and dabbing with sealant.
 - .2 Place setting blocks at 1/4 points, with edge block maximum 150mm from corners.

- .3 Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of light or glass unit.
 - .4 Install removable stops with spacer strips inserted between glazing and applied stops below sight line. Place glazing tape on glazing light or unit with tape 6mm below sight line.
 - .5 Fill gap between glazing and stop with sealant to depth equal to bite of frame on glazing, maximum 6mm below sight line.
 - .6 Apply cap bead of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.
- .3 Glazing Film Installation
- .1 Clean glass to receive film, thoroughly and let dry.
 - .2 Install plastic film in accordance with film manufacturer's instructions.
 - .3 Remove all air bubbles, creases or visible distortion.
 - .4 Fit tight to glass perimeter. Do not leave clear gaps.
 - .5 Provide glazing film to interior mirrors, screens and windows where indicated on the drawings. Final extent and design by the Consultant.
- 3.5 MIRROR INSTALLATION
- .1 Set mirrors with adhesive, applied in accordance with adhesive manufacturer's instructions. Install stainless steel mirror clips (6 per sheet) at perimeter edges of mirror installation (butt joints between mirror panels).
 - .2 Place plumb and level, in locations indicated on the drawings.
- 3.6 CLEANING & PROTECTION
- .1 During installation, remove all corrosive or foreign materials or droppings resulting from work of this trade.
 - .2 Perform initial cleaning operation of all glass and mirrors upon completion of installation. Do not remove labels or protective films until time of final cleaning.
 - .3 After initial cleaning, mark large lites with an "X" by using removable plastic tape. Do not use masking tape. Do not mark heat absorbing or reflective glass units.
 - .4 Provide instructions for the proper method and materials to be used in the cleaning and maintenance of finished surfaces. Remove all remaining labels and protective films at time of final cleaning.

3.7 GLAZING TYPES

- .1 Refer to the Drawings for the locations and extent of all glazing types.
 - .1 GL1: Insulating Glass Unit; Insulating Glass Unit; Tempered Clear Glass outer lite, and Tempered Low-E Glass (3) inner lite. Glass Surface Pattern where indicated.
 - .2 GL2: Insulating Glass Units, clear laminated glass inner lite and tempered safety glass outer lite, with specified low emissivity coating on No. 2 surface. Glass Surface Pattern where indicated.
 - .3 FG: Fire Resistive Glass for glazing in Fire Resistance Rated (FRR) glazing assemblies.
 - .1 FG.1: 8mm Fire-rated, ceramic safety glass (FireLiteNT)
 - .4 TG: Clear tempered safety glass.
 - .1 Interior Screens: tempered safety glass, thickness as shown on the drawings.
 - .5 LG: Laminated Glass; 2 layers - 6mm heat strengthened glass with 1.52mm Vanceva PVB interlayer.
 - .1 Interlayer Colour: Vanceva Clear.
 - .6 MG: Mirror glass; thickness as indicated on the drawings.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide exterior louvers and vents including the following:
 - .1 Fixed wall louvers.

1.3 REFERENCES

- .1 Aluminum Association (AA); DAF-45, Designation System for Aluminum Finishes.
- .2 American Architectural Manufacturers Association (AAMA); Aluminum Curtain Wall Design Guide Manual.
- .3 ASTM B209; Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .4 ASTM B221M; Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
- .5 ASTM E330; Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- .6 CAN/CSA G164; Hot Dip Galvanizing of Irregularly Shaped Articles.
- .7 CAN3-S157; Strength Design in Aluminum.

1.4 PERFORMANCE REQUIREMENTS

- .1 Structural performance shall be based on CAN3-S157, Strength Design in Aluminum, and a maximum deflection of 1/175 of the span, when subjected to positive and negative wind loads based on Ontario Building Code 30 year probability.

- .2 Vibration: design louver assemblies to not vibrate or rattle under design wind loading.
- .3 Design louvers for minimum 45% free area.
- .4 System to provide for expansion and contraction within system components caused by a cycling temperature range of 95°C over a 12 hour period without causing detrimental affect to system components.
- .5 Drain water entering joints, or migrating moisture occurring within system, to the exterior by a weep drainage network.
- .6 System design shall be the responsibility of a Professional Engineer registered in the Province of Ontario.

1.5 SUBMITTALS

- .1 Samples
 - .1 Submit one representative corner model of each type of louver and vent showing frame detail, screening and finish, in accordance with Section 01 30 00.
- .2 Shop Drawings
 - .1 Submit shop drawings indicating fabrication and erection details, including anchorage, accessories, electrical connections and finishes, in accordance with Section 01 30 00.
 - .2 Louvers shall be engineered to conform to requirements for all applicable loads. Shop drawings shall bear the stamp of a Professional Engineer, registered in the Province of Ontario.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Louver and vent units shall be shipped to the site in protective crating or packaging.
- .2 Store units on pallets or other supports, away from construction traffic.

1.7 MAINTENANCE DATA

- .1 Provide all data for operation and maintenance of louvers for incorporation into Operations and Maintenance manual.

1.8 WARRANTY

- .1 Provide a manufacturer's warranty in the name of the Owner, warranting the finish on all louvers against fading, cracking, crazing, peeling or other deformation for a period of 20 years from Date of Substantial Performance

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 AiroLite.
- .2 C/S Construction Specialties Inc.
- .3 E.H. Price.
- .4 TenPlus Architectural.

2.1 MATERIALS

- .1 Aluminum: extruded 6063-T52 aluminum alloy frames and blades, minimum 3mm thickness.
- .2 Bird screens: 1.6mm diameter, 13mm mesh, intercrimped black aluminum wire secured to 2mm thick black extruded aluminum frame mitred at corners and secured with corner locks.
- .3 Sealants: to Section 07 92 00.

2.2 WALL LOUVERS

- .1 Fixed Blade Louvers: 152mm deep, drainable fixed horizontal louvers. Heads, sills, jambs and mullions to be one-piece structural aluminum members with integral caulking slot and retaining beads. Mullions shall be sliding interlock with integral drains. Blades to be one-piece aluminum extrusions with front lip gutter and multiple secondary gutters designed to catch and direct water to jamb and mullion downspouts. Louvers to be supplied with full depth sill flashings formed from minimum 1.27mm thick aluminum. Sill flashings to have welded side panels. Louvers and sill flashings to be installed in accordance with the manufacturer's recommended procedures to ensure complete water integrity performance of the louver system. External corners shall be mitered to provide continuous line appearance. Mullions to be provided where indicated. Louver sizes as indicated on the drawings.
 - .1 C/S Model A6177 drainable blade type, by C/S Construction Specialties Inc.
 - .2 AMCA Performance: A 2440mm x 2440mm unit shall conform to the following:
 - .1 Free Area: 53.9%.
 - .3 Finish
 - .1 Fluoropolymer Paint: Kynar 500® based, factory-applied, thermosetting, 2-coat fluoropolymer paint system, to AAMA 605.2, consisting of a prime coat, and colour coat. Colour: to match Steel Siding specified in Section 07 46 19.
 - .1 Duranar (2 Coat System), by PPG Canada Inc.
 - .2 Fluoropon (2 Coat System), by The Valspar Corporation.

2.3 FABRICATION

- .1 General
 - .1 Construct louver frames and blades from aluminum extrusions.

- .2 Blades to be supported and aligned with extruded aluminum blade braces interlocked to each blade and mechanically fastened to structural frame angles.
- .3 Where louvers wrap around corners, mitre and weld all blades and braces.
- .4 Install concealed aluminum structural angle stiffeners, spaced maximum to meet required loads.
- .5 Attach screen to inside face of louvers.
- .6 Apply protective masking cover on exposed surfaces before shipping.

3 EXECUTION

3.1 INSTALLATION

- .1 Install louvers and vents plumb, square and level where indicated.
- .2 Set adjustable louver blades for uniform alignment in open and closed positions.
- .3 Adjust operable louvers so moving parts operate smoothly.
- .4 Repair damage to louvers and vents to match original finish.

3.2 ISOLATION COATING

- .1 Isolate aluminum from following components, by means of isolation coating:
 - .1 All dissimilar metals except stainless steel, zinc, or white bronze.
 - .2 Concrete, masonry, and mortar.
 - .3 Untreated wood.

3.3 CAULKING

- .1 Apply sealants in accordance with Section 07 92 00.

3.4 CLEANING

- .1 During installation, remove all corrosive or foreign materials or droppings resulting from work of this or other trades. Provide instructions for the proper method and materials to be used in the final cleaning of finished surfaces.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide gypsum board systems including the following:
 - .1 Non-load bearing steel stud systems
 - .2 Steel ceiling & soffit suspension systems
 - .3 Gypsum board
 - .4 Cement board
 - .5 Sheathing Board
 - .6 Taping & Jointing
 - .7 Accessories

1.3 REFERENCES

- .1 ASTM C473; Test Methods for Physical Testing of Gypsum Panel Products.
- .2 ASTM C475; Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .3 ASTM C630/C630M; Specification for Water-Resistant Gypsum Backing Board.
- .4 ASTM C645; Specification for Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.
- .5 ASTM C840; Specification for Application and Finishing of Gypsum Board.
- .6 ASTM C954; Specification for Steel Drill Screws for the Application of Gypsum Board.
- .7 ASTM C1002; Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases.

- .8 ASTM C1047; Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- .9 ASTM C1178; Specification for Glass Mat Water-Resistant Gypsum Backing Board.
- .10 ASTM C1395/C1395M; Specification for Gypsum Ceiling Board.
- .11 ASTM C1396/C1396M; Specification for Gypsum Board.
- .12 ASTM D3273; Test Method for Resistance to Mold Growth on the Surface of Interior Coatings in an Environmental Chamber.
- .13 ASTM-E90; Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
- .14 ASTM-E119; Test Methods for Fire Tests of Building Construction and Materials.
- .15 CAN/CGSB-51.34; Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .16 CAN/CGSB-71.25; Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.
- .17 CAN/ULC-S102; Building Materials and Assemblies, Standard Method of Test for Surface Burning Characteristics of.
- .18 CAN/ULC-S114; Determination of Non-combustibility of Building Materials.
- .19 CAN/CSA-S136; Cold Formed Steel Structural Members.

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

1.5 SUBMITTALS

- .1 Samples: Submit samples in accordance with Section 01 30 00.
- .2 Submit duplicate 300mm x 300mm samples of the Gypsum Rendering finish system, on 16mm gypsum board. Samples shall show all materials, application and specified finish.

1.6 SYSTEM REQUIREMENTS

- .1 Performance Requirements: Fabricate and install systems as indicated but not less than that required to comply with ASTM C754 under the following conditions:
 - .1 Standard systems: Maximum deflection of $l/240$ of partition height.
 - .2 Systems to receive water resistant gypsum board or backer board: Maximum deflection of $l/360$ of partition height.
 - .3 Interior suspended ceilings: Maximum deflection of $l/360$ of distance between supports.
 - .4 Exterior soffits and interior vestibule ceilings: Withstand minimum positive and negative pressure of 0.95kPa with maximum deflection of $l/360$ of distance between supports.
- .2 Tall Walls
 - .1 Partitions exceeding 9m in height are considered tall walls. Use double structural studs back-to-back 610mm on center. Attach studs back to back with screws approximately 1220mm on center. Alternately, use engineered steel stud assemblies. Refer to Section 05 41 00.
 - .2 All stud assemblies requiring wind load resistance design shall be Engineered Steel Stud assemblies as specified in Section 05 41 00.
- .3 Fire Resistance Ratings: Where fire resistance classifications are indicated, provide materials and application procedures identical to those listed by UL/ULC or tested according to ASTM-E119 for type of construction shown.
- .4 Acoustical Ratings: Where sound ratings are indicated, provide materials and application procedures identical to those tested by manufacturer to achieve Sound Transmission Class (STC) scheduled or indicated in accordance with ASTM-E90.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver material to site promptly without undue exposure to weather.
- .2 Deliver in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade.
- .3 Store above ground in dry, ventilated space.

- .4 Protect materials from soiling, rusting, or damage.
- .5 Store board to be directly applied to masonry walls at 21°C for 24 hours prior to installation.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain temperature minimum 10°C, maximum 21°C for 48 hours prior to and during application of gypsum boards and joint treatment, and for at least 48 hours after completion of joint treatment.
- .2 Apply board and joint treatment to dry, frost-free surfaces.

1.9 SEQUENCING

- .1 Co-ordinate installation of ceiling suspension systems with work of mechanical and electrical trades. Allow for completion of major items of work by mechanical and electrical trades prior to installation of ceiling grid systems.

2 PRODUCTS

2.1 STEEL MATERIALS

- .1 Sheet Steel: Cold-rolled, commercial grade structural quality sheet steel (SS), to ASTM A924/A924M; Zinc-Coated (Hot Dip Galvanized) to ASTM A653/A653M; coating designation Z275.

2.2 PARTITION FRAMING

- .1 Partition Stud Framing: to ASTM C645, stud sizes as indicated, roll-formed from 0.53mm thick, hot-dip galvanized sheet steel. Knock-out service holes at 460mm centres.
- .2 Partition Floor & Ceiling Tracks: to ASTM C645, 0.91mm thickness hot-dip galvanized sheet steel, widths to suit stud sizes, 32mm flange height for standard applications; 50mm flange height for deflection applications.
- .3 Stiffener Channels: 38mm or 64mm width, 1.3mm thick hot-dip galvanized sheet steel, cold rolled channels.

2.3 FURRING SYSTEMS

- .1 Metal furring runners, hangers, tie wires, inserts, anchors: to ASTM C645.
- .2 Drywall Furring Channels: 0.53mm core thickness hot-dip galvanized, steel channels for screw attachment of gypsum board.

2.4 FLAT CEILING SUSPENSION SYSTEM

- .1 Suspension System: tested in accordance with ASTM C635, roll formed from hot-dip galvanized, sheet steel; USG Drywall Suspension System by CGC Inc., or an approved alternative, and as follows:
 - .1 Main Tees: 38mm x 38mm, single web construction.
 - .2 Wall-to-Wall Main Tees: 38mm x 38mm, single web construction.
 - .3 Cross Tees: 38mm x 38mm, single web construction.

- .4 Cross Channels: 73x22mm, with 37mm face width.
- .5 Wall Channels: 40x25mm, "C" channel.
- .6 Wall Molds: 38 x 25mm "L" profile.
- .2 Splice and Transition clips: purpose-made, roll formed from hot-dip galvanized steel sheet by USG, or an approved alternative.
- .3 Suspension wire: 2.75mm galvanized wire.

2.5 BOARD MATERIAL

- .1 Standard Board: to ASTM C36, regular 13mm thick, 1220mm wide x maximum practical length, ends square cut, edges tapered.
 - .1 Regular Gypsum Board, by CertainTeed Gypsum Canada Inc.
 - .2 Sheetrock® Gypsum Board, by CGC Inc.
 - .3 Gold Bond Gypsum Board, by National Gypsum.
 - .4 ToughRock®, by G-P Gypsum (Georgia-Pacific)
- .2 Fire Rated Board (Type C): to ASTM C36, (5/8") 16mm thick, (48") 1220mm wide x maximum practical length, ends square cut, edges tapered.
 - .1 Type C Gypsum Board, by CertainTeed Gypsum Canada Inc.
 - .2 Sheetrock® Firecode Type C, by CGC Inc.
 - .3 Gold Bond Fire-Shield C Gypsum Board, by National Gypsum.
 - .4 ToughRock™ Fireguard C Gypsum Board, by Georgia Pacific.
- .3 Fire Rated Board (Type X): to ASTM C36, Type X to ASTM E119, (5/8") 16mm thick, (48") 1220mm wide x maximum practical length, ends square cut, edges tapered.
 - .1 Type X Gypsum Board, by CertainTeed Gypsum Canada Inc.
 - .2 Sheetrock® Firecode Type X, by CGC Inc.
 - .3 Gold Bond Fire-Shield Gypsum Board, by National Gypsum.
 - .4 ToughRock™ Fireguard Gypsum Board, by Georgia Pacific.
- .4 Moisture Resistant Gypsum Board: to ASTM C36, with water resistant facing, Type X to ASTM E119, 16mm thick, 1220mm wide x maximum practical length;
 - .1 M2Tech® Moisture and Mold Resistant Type X Gypsum Board, by CertainTeed Gypsum Canada Inc.
 - .2 Sheetrock Mold-Tough Panels, by CGC Inc.
 - .3 Gold Bond XP Gypsum Board, by National Gypsum.
 - .4 ToughRock® Mold-Guard, by G-P Gypsum (Georgia-Pacific)
- .5 Interior Ceiling Panels: to ASTM C1395, Type X to ASTM E119, 16mm thick, 1220mm wide x 2440mm long;
 - .1 Easi-Lite Lightweight Interior Ceiling Board, by CertainTeed Gypsum Canada Inc.
 - .2 Sheetrock® Interior Ceiling Board, by CGC Inc.
 - .3 Gold Bond Interior High-Strength LITE, by National Gypsum.
 - .4 ToughRock™ Span 24, by G-P Gypsum (Georgia-Pacific)
- .6 Cement Board Panels: fiberglass reinforced cement board to ANSI A118, 13mm thick, 1220mm wide x 2440mm long;
 - .1 PermaBase® by UniFix Inc., Bromont Quebec.

- .2 Durock® by CGC Inc.
- .3 Fiber Cement Backer Board, by CertainTeed Gypsum Canada Inc.

- .7 Tile Backer Board: to ASTM C1178, standard 13mm thick, and 16mm Type X to ASTM E119, 1220mm wide x 2440mm long;
 - .1 Diamondback Tile Backer, by CertainTeed Gypsum Canada Inc.
 - .2 DensShield® Tile Backer, by G-P Gypsum (Georgia-Pacific).
 - .3 Gold Bond e²XP® Tile Backer, by National Gypsum.

- .8 Glass Mat Exterior Sheathing Board: to ASTM C931, C1177, and C1278; standard 16mm thick, 1220mm wide x maximum practical length;
 - .1 GlasRoc™ Exterior Sheathing by CertainTeed Gypsum Canada Inc.
 - .2 DensGlass Gold Exterior Guard, by G-P Gypsum (Georgia-Pacific).
 - .3 Securock® Glass-Mat Sheathing, by CGC Inc.
 - .4 Gold Bond e²XP® Extended Exposure Gypsum Sheathing, by National Gypsum.

2.6 ACCESSORIES

- .1 Hanger Wire: 4.8mm galvanized pencil rod.

- .2 Screws
 - .1 For interior board: #6 or #8 bugle head, to ASTM C954, hardened and phosphate plated, drywall screws. Use self-drilling type for heavier thickness framing material.
 - .2 For exterior sheathing board: self-tapping, corrosion-resistant, screws and plates, Deklite by DeckFast, or equivalent.

- .3 Laminating Compound: as recommended by gypsum board manufacturer for laminating multiple layers of gypsum board, or for laminating gypsum board to masonry or concrete.

- .4 Corner Beads: 0.53mm thick, commercial grade, hot-dip galvanized sheet steel, to ASTM C645, perforated flanges, one piece length per location, refer to drawings for details and locations;
 - .1 "D-100" series, by Bailey Metal Products.

- .5 Drywall Trims: 6063-T5 extruded aluminum trims and moldings, factory primed finish for site painting, one-piece length per location, by Fry Reglets. Refer to drawings for details and locations;
 - .1 Reveal Molding: Drywall Reveal Molding, non-vented, "DRM 50-50" Series (13mm wide x board thickness).
 - .2 Reveal Molding: Ceiling Reveal Molding DRWT 50-50.
 - .3 J Moldings: JDM 50 and JDM 625.
 - .4 Control Joint: DRM 50-50 2PC, and DRM 50-50 3PC.
 - .5 Z Reveal Molding: DRMZ 50-50.

- .6 Polyethylene: to CAN/CGSB-51.34.

- .7 Acoustical Sealant: to Section 07 92 00.

- .8 Firestop and Smoke Sealants: to Section 07 84 00.

- .9 Insulating Strip: rubberized, moisture-resistant, 3mm thick, closed cell neoprene strip, 12mm wide, with self sticking permanent adhesive on one face; lengths as required.
- .10 Joint Tape: Paper tape, nominal 50mm wide.
- .11 Joint Compounds: to ASTM C475, dry powder for mixing with water, or ready-mix compounds;
 - .1 Standard Interior Use Joint Compound
 - .1 M2Tech Setting Compound, by CertainTeed Gypsum Canada Inc.
 - .2 DensArmor™ Sandable Joint Compound, by Georgia-Pacific.
 - .3 Sheetrock Setting-Type Joint Compound, by CGC Canada Inc.
- .12 Water: potable.

3 EXECUTION

3.1 GENERAL

- .1 Perform work in accordance with ASTM C840 except where specified otherwise.

3.2 PARTITION CONSTRUCTION

- .1 Align top and bottom partition tracks at floor and ceiling and secure at 610mm o.c. maximum.
- .2 Secure partitions under acoustic ceiling grids with partition clips at 1220mm o.c. maximum and additionally at ends of return walls, and above each door jamb.
- .3 Install polyethylene dampproof course under stud shoe tracks of partitions on slabs on grade.
- .4 Place studs vertically at 406mm o.c. and not more than 50mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .5 Erect metal studding to tolerance of 1:1200.
- .6 Attach studs to bottom and ceiling track using screws.
- .7 Coordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .8 Coordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.

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- .9 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
 - .10 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.
 - .11 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
 - .12 Install steel studs or furring channels between studs as required for attaching electrical and other boxes.
 - .13 Extend framing above suspended ceilings for fire and sound separations and to form plenum areas as indicated.
 - .14 Extend partitions to underside of floor/roof deck above except where noted otherwise on drawings. Provide cross-bracing above ceilings, where recommended by manufacturer.
 - .15 Where partitions are fire, smoke, or sound separations, and occur parallel to, and under structural members, offset and continue partitions to underside of floor/roof deck above to maintain continuity of partition.
 - .16 Maintain clearance under beams, joists, and structural slabs to avoid transmission of structural loads to studs. Use 50mm leg ceiling tracks or double track slip joint as indicated.
 - .17 Install continuous insulating strips to isolate studs from uninsulated surfaces, or dissimilar metals.
 - .18 Install two continuous beads of acoustical sealant or insulating strip under studs and tracks around perimeter of sound control partitions.
- 3.3 FURRING INSTALLATION
- .1 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.
 - .2 Furr for gypsum board faced vertical bulkheads within or at termination of ceilings.
 - .3 Install wall furring for gypsum board wall finishes where indicated.
 - .4 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.

- .5 Furr, beams, columns, pipes and exposed services where indicated.
- .6 Install sound isolation clips and channels to assemblies indicated where scheduled on the drawings.

3.4 CEILING SYSTEM INSTALLATION

- .1 Erect metal framing to tolerance of 1:1200.
- .2 Install perimeter wall molds or channels level and straight, above elevation equal to thickness of board ceiling finish.
- .3 Install main channels/tees in parallel rows 1220mm o.c., supported on hanger wire at maximum 1220mm o.c. Align cross channel slots from one main runner to the next. End splices must be fully interlocked.
- .4 Install cross channels perpendicular to hanger channels at 405mm o.c. for moisture resistant board, soffit panels, and cement board; 610mm o.c. for all other. Screw fasten ends of furring channels to wall angles.
- .5 Provide wind support posts at 1220mm o.c. each way at exterior soffit applications.
- .6 Install additional cross channels within 200mm of parallel running walls where wall moulds or angles are not present.
- .7 Install cross channels parallel to, and at exact locations of steel stud partition header track.
- .8 Install standard cross tees at long edges of all rectangular light fixtures.
- .9 Frame openings and around built-in equipment, cabinets, access panels, on four sides with cross tees. Extend framing into reveals. Check clearances with equipment suppliers.
- .10 Ceiling suspension system shall not be used as primary support for mechanical/electrical equipment, other than those items penetrating the ceiling membrane or, to be installed on the underside of the ceiling. Other equipment must have its own support system.
- .11 Fire Rated System
 - .1 Install additional cross channels 200mm each side of ceiling board butt joints for full length of joint.
 - .2 Install additional cross channels 200mm from long edges of light fixture openings for additional board support.
 - .3 Install additional wire hangers at all corners of light fixtures and at centre points of supporting cross tees.
 - .4 Install ceiling edge fascias where indicated on the drawings.

- .5 Construct ceiling suspension systems to the following minimum fire rated designs:
 - .1 Up to 1 1/2 hours: UL Design G-528.
 - .2 Up to 2 hours: ULC Design I-517.
 - .3 Up to 3 hours: UL Design G-529.

3.5 BOARD APPLICATION

- .1 Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical work are approved.
- .2 Apply single layer gypsum board to wood or metal furring or framing using screw fasteners. Maximum spacing of screws 305mm o.c.
- .3 Apply double layer gypsum board to wood or metal furring or framing using screw fasteners for first layer, and laminating adhesive for second layer. Maximum spacing of screws 305mm o.c.
- .4 Apply single layer gypsum board to concrete or concrete block surfaces, where indicated, using laminating adhesive.
- .5 Apply moisture resistant gypsum board to walls and ceilings in where scheduled. Apply silicone sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads.
- .6 Apply cement board panels to all exterior tiled surfaces where noted and scheduled.
- .7 Apply tile backer board to all interior wall surfaces to receive tile finish. Apply using screw fasteners, at 305mm o.c maximum spacing.
- .8 Apply 13mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustical sealant.
- .9 Apply glass mat gypsum sheathing board in single layer, to exterior side of load bearing steel studs, using pan-head screw fasteners. Maximum spacing of screws 305mm o.c.

3.6 INSTALLATION OF ACCESSORIES

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure with screws at 152mm o.c., or using contact adhesive for full length.
- .2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

- .3 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .4 Construct control joints of back-to-back casing beads, set in gypsum board facing and supported independently on both sides of joint.
- .5 Provide continuous polyethylene dust barrier behind and across control joints.
- .6 Locate control joints at changes in substrate construction, at approximately 10000mm spacing on long corridor runs, at approximately 15200mm on ceilings.
- .7 Construct expansion joints as detailed, at building expansion and construction joints. Provide continuous dust barrier.
- .8 Install access doors to electrical and mechanical equipment where specified in Section 08 31 13 and by Mechanical and Electrical subtrades. Rigidly secure frames to furring or framing systems.
- .9 Install continuous aluminum soffit vents as indicated on the drawings. Install vent strip straight and true to line.

3.7 TAPING AND JOINTING

- .1 Provide levels of gypsum board finish for locations as follows, in accordance with Gypsum Association GA 214, Recommended Specification: Levels of Gypsum Board Finish.
 - .1 **Level 1:** Ceiling plenum and concealed areas, except provide higher level of finish as required to comply with fire resistance ratings and acoustical ratings.
 - .2 **Level 2:** Gypsum board substrate at tile, except remove tool marks and ridges.
 - .3 **Level 3:** Gypsum substrate under textured or applied coatings such as plaster.
 - .4 **Level 4:** Gypsum board surfaces to receive paint finish.
- .2 Interior Gypsum Board
 - .1 Pre-fill
 - .1 Use setting-type joint compound. Mix joint compound according to manufacturer's directions.
 - .2 Fill joints between boards flush to top of eased or beveled edge.
 - .3 Fill joints of gypsum board above suspended ceilings in fire-rated partitions.
 - .4 Wipe off excess compound and allow compound to harden.
 - .2 Taping (Level 1)
 - .1 Butter taping compound into inside corners and joints.
 - .2 Center tape over joints and press down into fresh compound.
 - .3 Remove excess compound.

- .4 Tape joints of gypsum board above suspended ceilings.
- .3 First coat (Level 2)
 - .1 Use taping or all-purpose drying-type compound.
 - .2 Immediately after bedding tape, apply skim coat of compound and allow to dry completely in accordance with manufacturer's instructions.
 - .3 Apply first coat of compound over flanges of trim and accessories, and over exposed fastener heads and finish level with board surface.
- .4 Second coat (Level 3)
 - .1 After first coat treatment is dried, apply second coat of compound over tape and trim, feathering compound 2 inches beyond edge of first coat.
- .5 Third coat (Level 4)
 - .1 After second coat has dried, sand surface lightly and apply thin finish coat to joints, fasteners and trim, feathering compound 2 inches beyond edge of second coat.
 - .2 Allow third coat to dry. Apply additional compound, and touch-up and sand, to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.
- .3 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
- .4 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .5 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide tiling to floors and walls where scheduled.

1.3 REFERENCE STANDARDS

- .1 ANSI A108 Series; Specifications for Installation of Ceramic Tile.
- .2 ANSI A118 Series; Specifications for Mortars and Grouts for Ceramic Tile Installation.
- .3 ANSI A136.1; Standard for Organic Adhesives for Installation of Ceramic Tile.
- .4 ANSI A137.1; Recommended Standard Specifications for Ceramic Tile.
- .5 ASTM C1027; Determining visible abrasion resistance of glazed ceramic tile.
- .6 ASTM C1028; Determining the static coefficient of ceramic tile.
- .7 ASTM C920; Elastomeric joint sealants.
- .8 CAN/CGSB-75.1; Ceramic tile.
- .9 Ceramic Tile Installation Manual 200; Terrazzo Tile and Marble Association of Canada (TTMAC).
- .10 Handbook for Ceramic Tile Installation; Tile Council of America.

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication

of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

.2 Installation/Application

.1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.

.3 Documentation

.1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.

.4 Pre-application Meeting

.1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:

.1 Contractor (Site Superintendent & Project Manager)

.2 Application Subcontractor (Site Foreman & Project Manager)

.3 Product Manufacturer and/or Distributor (Technical Representatives)

.4 Related Subcontractors whose work is affected by that of this Section.

1.5 SUBMITTALS

.1 Submit sample panels of each tile type specified, in accordance with Section 01 30 00.

.2 Sample panels shall be minimum 600mm x 600mm in size, and shall consist of tiles bonded to 13mm G1S plywood, with grouted joints to represent project installation. Where cut tile patterns are indicated, include one sample of cut condition. Sample boards shall include installation of corner conditions and other trim locations.

.3 Submit samples of preformed bases, trim and other specialty shapes.

1.6 MAINTENANCE MATERIAL

.1 Provide minimum 2% of each type and colour of tile required for project for maintenance use in accordance with Section 01 78 00.

.2 Maintenance material to be of same production run as installed material.

.3 Provide instructions for the care and maintenance of all tile for this project, for inclusion in Operations and Maintenance Manual.

1.7 ENVIRONMENTAL CONDITIONS

.1 Maintain air temperature and structural base temperature at ceramic tile installation area above 10°C for 48 hours before, during, and 48 hours after installation.

- .2 Exclude construction traffic from areas to receive tile during installation and curing period.
- .3 Protect tile flooring subjected to construction traffic with non-staining covers.

1.8 EXTENDED WARRANTY

- .1 Provide Mortar and Grout manufacturer's system warranty guaranteeing that the listed products, installed as per the manufacturer's approved methods and practices, will not fail due to material or manufacturing defects for a period of five (5) years from the Date of Substantial Performance.
- .2 Warranty shall cover the total replacement cost (all labour and materials) of the defective area.

2 PRODUCTS

2.1 TILE MATERIALS

- .1 Floor Tile:
 - .1 FT-1
 - .1 Product: Glocal, by Centura Tile (Deborah McCarthy);
 - .2 Size: 300mm x 600mm.
 - .3 Colour: as selected by the Consultant.
- .2 Wall Tile:
 - .1 WT-1
 - .1 Product: Rainbow, by Centura Tile (Deborah McCarthy);
 - .2 Size: 100mm x 400mm.
 - .3 Colour: as selected by the Consultant.
 - .2 WT-2
 - .1 Product: Argile, by Centura Tile (Deborah McCarthy);
 - .2 Size: 65mm x 250mm.
 - .3 Colour: as selected by the Consultant.
 - .3 WT-3
 - .1 Product: Penny Round Mosaic, by Centura Tile (Deborah McCarthy);
 - .2 Size: 300mm x 300mm sheet.
 - .3 Colour: as selected by the Consultant.

2.1 MORTAR AND ADHESIVE MATERIALS

- .1 Thin Set Mortar: latex-modified Portland cement thin-set mortar, to ANSI 118.4. Acceptable products are:
 - .1 Kerabond/Keralastic by Mapei Inc.

- .2 Laticrete® 4237/211, by Laticrete International Inc.
 - .3 TEC™ Full Flex™ 390/391, by H.B Fuller Construction Products Inc.
 - .4 Premium-Blend™/Acrylic Mortar Admix, by Custom Building Products.
 - .5 ARDEX X4™ Thin Set Mortar, by Ardex Engineered Cements.
- .2 Large Format Tile Mortar: latex-modified Portland cement mortar, to ANSI 118.4. Acceptable Products are:
- .1 Ultraflex LFT by Mapei Inc.
 - .2 Laticrete® 220/333, by Laticrete International Inc.
 - .3 TEC™ Ultimate Large Tile Mortar 382/383, by H.B Fuller Construction Products Inc.
 - .4 ProLite™ Premium LFT, by Custom Building Products.
 - .5 ARDEX X77™ MICROTEC® Fibre-Reinforced Thin Set Mortar, by Ardex Engineered Cements.
- .3 Epoxy Mortar (Showers): two-component, 100% solids epoxy mortar, to ANSI 118.4. Acceptable Products are:
- .6 Kerapoxy by Mapei Inc.
 - .7 Latapoxy® 300, by Laticrete International Inc.
 - .8 TEC™ TA-470, by H.B Fuller Construction Products Inc.
 - .9 100% Solids Epoxy Mortar, by Custom Building Products.
 - .10 ARDEX WA™ Epoxy Grout/Adhesive, by Ardex Engineered Cements.
- .4 Organic Adhesive: to ANSI 136.1/CGSB 71-GP-22M, Type I. Acceptable Products are:
- .1 Ultra/Mastic 1 by Mapei Inc.
 - .2 TEC™ TA-101 Adhesive, by H.B Fuller Construction Products Inc.
 - .3 Latamastic® 9, by Laticrete International Inc.
 - .4 TripleGrip™, by Custom Building Products.
 - .5 ARDEX D14™ Premixed Tile Adhesive, by Ardex Engineered Cements.
- 2.3 GROUT
- .1 Sanded Grout: sanded, latex-modified Portland cement grout, to ANSI 118.6. Colours as selected by Consultant. Acceptable Products are:
- .1 Ker 200 Series, by Mapei Inc.
 - .2 Laticrete® 500/1776, by Laticrete International Inc.
 - .3 TEC™ AccuColor™ TA-650/869, by H.B Fuller Construction Products Inc.
 - .4 Polyblend® Sanded, by Custom Building Products.
 - .5 ARDEX FL™ Rapid-Set Flexible Sanded Grout, by Ardex Engineered Cements.
- .2 Unsanded Grout: unsanded, dry, latex-modified Portland cement grout, to ANSI 118.6. Colours as selected by Consultant. Acceptable Products are:
- .1 Ker 800 Series, by Mapei Inc.
 - .2 Laticrete® 1600 Series TriPoly Grout/1776 Admix Plus, by Laticrete International Inc.

- .3 TEC™ AccuColor TA-620/869, by H.B Fuller Construction Products Inc.
 - .4 Polyblend® Unsanded, by Custom Building Products.
 - .5 ARDEX FG-C™ MICROTEC® Unsanded Grout, by Ardex Engineered Cements.
- .3 Epoxy Grout (Showers): two-component, 100% solids epoxy grout, to ANSI 118.6. Colours as selected by Consultant. Acceptable Products are:
- .1 Kerapoxy®, by Mapei Inc.
 - .2 SpectraLOCK® PRO, by Laticrete International Inc.
 - .3 TEC AccuColor EFX™, by H.B. Fuller Construction Products Inc.
 - .4 CEG 2000™, by Custom Building Products.
 - .5 ARDEX WA™ Epoxy Grout/Adhesive, by Ardex Engineered Cements.

2.4 ACCESSORIES

- .1 Floor Patch & Leveller: latex-modified cement floor patch and leveller. Acceptable products are;
- .1 Planipatch, by Mapei Inc.
 - .2 TEC™ VersaPatch TA-327, by H.B Fuller Construction Products Inc.
 - .3 Laticrete® 816 Latipatch Rapid Underlayment, by Laticrete International Inc.
 - .4 ARDEX Liquid BackerBoard™ Underlayment, by Ardex Engineered Cements.
- .2 Anti-Fracture Membrane: two-part, cold-applied, fabric-reinforced, liquid rubber membrane. Acceptable Products are;
- .1 Mapelastic PRP-M19, by Mapei Inc.
 - .2 Laticrete® Blue 92 Anti-Fracture Membrane, by Laticrete International Inc.
 - .3 TEC™ Triple Flex TA-324, by H.B Fuller Construction Products Inc.
 - .4 RedGard Crack Prevention Membrane, by Custom Building Products.
- .3 Tile Grout Release: water-based silicone, pre-grout sealer for stone and marble. Acceptable Products are:
- .1 511 H₂O Water Base Penetrating Sealer, by Miracle Sealants Company.
 - .2 GroutRite, by H.B Fuller Construction Products Inc.
 - .3 Aquamix Penetrating Sealer, by Custom Building Products.
- .4 Joint Sealer: polymerized silicone grout sealer. Acceptable products are:
- .1 Grout Sealer, by Miracle Sealants Company.
 - .2 TEC™ TA-256, by H.B Fuller Construction Products Inc.
 - .3 Aquamix Grout Sealer, by Custom Building Products.
- .5 Waterproofing Membrane: two-component, trowel-applied waterproof membrane. Acceptable Products are:
- .1 TEC Hydraflex, by H.B Fuller Construction Products Inc.

- .2 PRP 315, by Mapei Inc.
- .3 ARDEX 8+9™ Rapid Waterproofing, by Ardex Engineered Cements.

- .6 Reinforcing mesh: (1/4") 6mm thick interlocking plastic or fiberglass grid.

- .7 Sealant: neutral-cure, non-sag, 100% silicone sealant, mold and mildew resistant; colour to match grout. Acceptable Products are:
 - .1 ARDEX SX™ Silicone Sealant, by Ardex Engineered Cements.
 - .2 TEC 100% Silicone, by H.B Fuller Construction Products Inc.

- .8 Transitions:
 - .1 Floor Trims: brushed stainless steel finish for all;
 - .1 Edge Protection: Schluter-RENO-RAMP- (2") 50mm, by Schluter Systems (Canada) Inc.
 - .2 Floor Tile to Resilient Flooring: Schluter®-RENO-U, by Schluter Systems (Canada) Inc.
 - .3 Floor Tile to Tile/Wood Flooring: Schluter-DECO, by Schluter Systems (Canada) Inc.
 - .4 Floor Tile to Wall Tile: Schluter®-DILEX-AHK, by Schluter Systems (Canada) Inc.
 - .5 Expansion Joints: Schluter-DILEX-BT, by Schluter Systems (Canada) Inc.
 - .6 Shower Threshold: Schluter®-SHOWERPROFILE-WS/WSL, by Schluter Systems (Canada) Inc.
 - .2 Wall Caps: brushed stainless steel finish for all;
 - .1 Horizontal Top Edge Cap: Schluter-JOLLY, by Schluter Systems (Canada) Inc. with anodized aluminum finish.
 - .2 Vertical Corner Cap (90 deg): Schluter-JOLLY, by Schluter Systems (Canada) Inc. with anodized aluminum finish, with matching universal corners. Where tile is shown full height of wall, extend corner cap full height of tile.
 - .3 Wall Cap: Schluter®-jolly, by Schluter Systems (Canada) Inc.
 - .4 Edge Trim at Mirrors: Schluter®-JOLLY, by Schluter Systems (Canada) Inc.

- .9 Shower Kit
 - .1 Schluter®-KERDI-SHOWER-KIT™, by Schluter® Systems (Canada) Inc., including sloped shower floor, curb, waterproofing membrane, and drain;
 - .1 KERDI-SHOWER-ST™: trapezoid-imprinted, prefabricated, sloped shower tray base, made of (74.16 lb/yd³) 44 kg/m³ density, self-extinguishing (HF-1 rating per UL-94) expanded polystyrene, with 313mm diameter removable recessed section with 3 mm wide ribs on top and channels on the underside.
 - .1 Size: ST-122 – (48" x 72" x 1½") 1220mm x 1830mm x 38mm.

- .2 KERDI-SHOWER-SC™: trapezoid-imprinted, prefabricated shower curb base, made of (74.16 lb/yd³) 44 kg/m³ density, self-extinguishing (HF-1 rating per UL-94) expanded polystyrene. Curb dimensions are (48" x 6" x 4½") 1220mm x 150mm x 115mm.
- .3 KERDI-WATERPROOF-MEMBRANE™: polyethylene waterproofing membrane with fleece webbing facings; vapour permeance of 0.75 perms.
- .4 KERDI-FIX™: single-component, elastomeric, waterproof sealing and bonding compound with a silane-modified polymer base. Compound is free of solvents and odorless.
- .5 KERDI-LINE™ DRAIN: stainless steel linear floor drain. Drain listed by CSA to meet requirements of the Canadian Standards Association standard, "Floor, Area, and Shower Drains, and Cleanouts for Residential Construction" (CSA B79), and referenced in method B422 of the Tile Council of North America Handbook for Ceramic Tile Installation.
 - .1 Basis for Design: KL1IV60E140.
 - .2 Length 1400mm.
 - .3 Drain Housing Material: stainless steel.
 - .4 Grate Material and Finish: Stainless Steel Type 304 = V2A.
 - .5 Grate Design: as selected by the Consultant.
- .6 KERDI-BAND™: corner accessories.
- .7 KERDI-SEAL™: pipe penetrations.

2.5 MORTAR MIXES

- .1 Thin Set System: (1.6gal) 7.6L polymer additive to (50lb) 22.7kg powdered mortar mix.
- .2 Epoxy System: mix as per manufacturer's instructions.
- .3 Mix as per manufacturer's instructions.
- .4 Measure mortar ingredients by volume. Mix thoroughly to smooth, homogeneous consistency.
- .5 Use low speed mixer (150 rpm). Avoid air entrapment and prolonged mixing.
- .6 Let slake 10 to 15 minutes. Re-stir without adding liquid.

3 EXECUTION

3.1 SURFACE PREPARATION

- .1 Ensure substrates are dry, clean, and free of all oil, grease and other materials detrimental to the installation of setting bed materials.
- .2 Ensure substrates are sound, level, free of cracks greater than 3mm in width, and changes in elevation that may adversely affect installation.
- .3 Apply levelling or patch material to vertical and horizontal substrates as recommended by mortar and grout manufacturer and allow to set thoroughly. Sand where necessary. Apply leveling coat to masonry and concrete surfaces to achieve sufficiently flat substrate for tiling, with no waves, ridges or bumps.

3.2 QUALITY OF WORK

- .1 Fit tile around corners, fitments, fixtures, drains and other built-in objects. Maintain uniform joint appearance. Cut edges smooth and even.
- .2 Maximum surface tolerance (1:800).
- .3 Lay out tiles so perimeter tiles are minimum 1/2 size.
- .4 Sound tiles after setting and replace hollow-sounding units to obtain full bond.
- .5 Make joints between tile uniform and approximately 3mm wide, plumb, straight, true, even and flush with adjacent tile. Ensure sheet layout not visible after installation. Align patterns.
- .6 Make inside corners square butt joints, and outside corners bullnosed.
- .7 Use return edged (bullnosed) tiles at termination of wall tile panels, except where panel butts projecting surface or differing plane.
- .8 Clean installed tile surfaces after installation and grouting cured.

3.3 WATERPROOF MEMBRANE INSTALLATION

- .1 Apply waterproof membrane to interior floors where scheduled.
- .2 Apply waterproofing membrane with a straight, smooth, steel trowel of type recommended by the manufacturer. Reinforce with fiberglass mesh, firmly embedded in base coat. Apply second coat of waterproofing over mesh.
- .3 Carry waterproofing over curbs, and up surrounding walls minimum (6")152mm, but in no case visible in finished work.
- .4 Allow sufficient time for waterproof membrane to cure prior to installation of ceramic tiles.

3.4 TILE INSTALLATION

- .1 Apply setting bed material with a clean, round or square-notched trowel of type recommended for that material. Do not apply more material than can be covered with tiles in 10 minutes (approx. 1m²).
- .2 Place tiles firmly into setting bed using a slight twisting motion to ensure full contact. Immediately beat-in tile to flatten all ridges or notches.
- .3 Clean out joints of excess mortar, and wipe smudges from tile face.
- .4 Allow minimum 24 hours after installation of tiles, before grouting.

3.5 CONTROL JOINTS

- .1 Provide control joints around perimeter of large areas, around columns, in locations where area changes direction and where tile abuts other hard material. Place control joints directly over subfloor expansion/control joints.
- .2 Provide control joints for all exterior areas where indicated. Width of control joints to match grout joint width.
- .3 Fill joints with sealants in accordance with Section 07 92 00.
- .4 Keep building expansion and control joints free of mortar or grout.
- .5 Provide caulked joints at all internal wall corners and between wall and floor tile.

3.6 GROUTING

- .1 Prior to commencing floor tile grouting, apply grout release to tiles to protect from grout stain, and allow sufficient time to dry.
- .2 Dampen surface of tile with a damp towel. Do not flood or overly wet tiles.
- .3 Using a purpose-made rubber float, apply grout evenly by moving across tiles diagonally first in one direction and then in the opposite direction, to ensure joints are filled with material. Promptly remove excess grout as the work progresses, using rubber float.
- .4 Remove remaining grout using dampened towel and clean water, by repeatedly dragging towel across the surface of the tiles, rinsing the towel and changing the water frequently.
- .5 Allow grout to cure minimum 3 to 4 hours before cleaning off remaining grout "haze".

3.7 SEALING

- .1 Ensure all grout has cured, and all residual grout has been removed from tile.

- .2 Apply grout joint sealer with fine brush or narrow foam pad, to all grout joints in floor and wall tile. Remove all excess sealer from joints, and tile surfaces.
- .3 Prohibit foot traffic on tile surfaces until after complete curing of sealer.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide acoustic panel ceiling systems including the following:
 - .1 Acoustic ceiling panels
 - .2 Suspension grid systems
 - .3 Hangers and inserts

1.3 REFERENCES

- .1 ASTM-C635; Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
- .2 ASTM-C636; Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
- .3 CAN/CGSB-51.34; Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.
- .4 CAN/CGSB-92.1 Sound Absorptive Prefabricated Acoustical Units.
- .5 CSA-B111; Wire Nails, Spikes and Staples.
- .6 CAN/ULC-S102; Surface Burning Characteristics of Building Materials.

1.4 REGULATORY REQUIREMENTS

- .1 Fire-resistance rated floor/ceiling and roof/ceiling assembly: certified by a Canadian Certification Organization accredited by Standards Council of Canada.

1.5 DESIGN REQUIREMENTS

- .1 Maximum deflection: 1/360th of span to ASTM-C635 deflection test.
- 1.6 QUALITY ASSURANCE
- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
 - .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.7 SUBMITTALS
- .1 Submittals: Make submittals in accordance with Section 01 30 00.
 - .2 Samples
 - .1 Submit one representative model of each type ceiling suspension system.
 - .2 Ceiling system to show basic construction and assembly, treatment at walls, recessed fixtures, splicing, interlocking, finishes, acoustical unit installation.
 - .3 Submit duplicate full size samples of each type acoustical panels in specified finishes.
 - .3 Closeout Submittals
 - .1 Maintenance Materials

- .1 Provide acoustical ceiling panels amounting to $\pm 2\%$ of gross ceiling area for each pattern and type required for project, in accordance with Section 01 78 00.
- .2 Extra materials shall be from same production run as installed materials, in unopened packages clearly identified as to its contents.
- .3 Store where directed by Consultant.

1.8 MOCK-UPS

- .1 Construct mock-ups in accordance with Section 01 30 00.
- .2 Construct one complete room (approx. 3m x 3m) of each type of acoustic panel ceiling in place, complete with wall molds suspension system grid and panels.
- .3 Allow for review by Consultant. Correct deficiencies.
- .4 Approved mock-up may form part of the finished Work, and shall serve as the minimum standard for work of this type.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Permit wet work to dry before commencement of installation.
- .2 Maintain uniform minimum temperature of 15°C and humidity of 20 - 40% before and during installation.
- .3 Store materials in work area 48 hours prior to installation.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 Suspension Grid
 - .1 CertainTeed Canada
 - .2 CGC Inc.
 - .3 Armstrong World Industries
- .2 Acoustic Panels
 - .1 CertainTeed Canada
 - .2 CGC Inc.
 - .3 Armstrong World Industries

2.2 STEEL MATERIALS

- .1 Sheet Steel: Cold-rolled, commercial grade structural quality sheet steel, to ASTM A635/A635M; Zinc-Coated (Hot Dip Galvanized) to ASTM A653/A653M; coating designation Z275.

2.3 SUSPENSION GRID SYSTEMS

- .1 Intermediate duty suspension grid systems, all components to be sheet steel to ASTM-C635, galvanized to ASTM A653/A653M. Die cut components; double web main tees with rectangular bulb and rolled cap on exposed face; shop painted baked enamel finish. Cross tees with rectangular bulb and web extended to form positive interlock with main tee webs, lower flange extended and offset to provide flush intersection.
 - .2 Standard Grid: 23mm wide exposed T-grid;
 - .1 Colour: white.
 - .2 Acceptable Products:
 - .1 15/16" Classic Stab System, by CertainTeed.
 - .2 Prelude XL, by Armstrong.
 - .3 Wall Molds: 23mm wide, to suit grids specified above; colours to match grid.
- 2.4 ACOUSTIC CEILING PANELS
- .1 Lay-in Acoustic Panels: to ASTM E1264, Type XII, Form 2, Pattern E, square-cut edges for standard (7/8") 23mm wide grid;
 - .1 Size: (24") 610mm x (24") 610mm x (3/4") 19mm thick.
 - .2 Pattern: fine textured.
 - .3 Finish: factory-applied latex paint.
 - .4 Colour: White.
 - .5 CAC: 42.
 - .6 NRC: 0.85.
 - .7 Acceptable Products
 - .1 Symphony *m* RX (High NRC and high CAC), by CertainTeed.
 - .2 Lyra PB High CAC, by Armstrong.
- 2.5 ACCESSORIES
- .1 Hanger Wire: galvanized soft annealed steel wire, 3.6mm diameter for access tile ceilings to ULC/UL tested design requirements for fire rated assemblies, 2.6mm diameter for other ceilings.
 - .1 Hanger Inserts: purpose-made for individual substrate.
 - .2 Carrying Channels: or 38 or 64mm, hot-dip galvanized steel.
- 3 EXECUTION**
- 3.1 EXAMINATION
- .1 Do not install ceiling suspension system or acoustical panels and tiles until work above ceiling has been inspected by Consultant.
- 3.2 SUSPENSION SYSTEM INSTALLATION
- .1 Install suspension system in accordance with ASTM-C636, to manufacturer's instructions, ULC/UL requirements, and this specification.
 - .2 Secure hangers to overhead structure using attachment methods acceptable to Consultant.

- .3 Install hangers spaced at maximum 1220mm centres and within 150mm from ends of main tees.
 - .4 Where mechanical or electrical equipment prohibit installation of hangers, provide carrying channels as required to span under equipment.
 - .5 Lay out system according to reflected ceiling plan.
 - .6 Ensure suspension system is coordinated with location of related components.
 - .7 Install wall mold level to provide correct ceiling height.
 - .8 Completed suspension system to support superimposed loads, such as lighting fixtures, diffusers, grilles, and speakers.
 - .9 Support light fixtures with additional ceiling suspension hangers at each corner and at maximum 600mm around perimeter of fixture.
 - .10 Supplementary support hangers for all tile-mounted mechanical and electrical fixtures shall be provided by those trades.
 - .11 Interlock cross members to main runner to provide rigid assembly.
 - .12 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.
 - .13 Finished ceiling system to be square with adjoining walls and level within 1:1000.
- 3.3 EXPANSION JOINTS
- .1 Supply and install "Z" shaped metal trim pieces at each side of expansion joint. Design to accommodate plus or minus 25mm movement and maintain visual closure. Finish metal components to match adjacent exposed metal trim. Provide backing plates behind butt joints.
- 3.4 ACOUSTIC PANEL INSTALLATION
- .1 Install lay-in panels in correct seated position in ceiling suspension system.
 - .2 In fire rated ceiling systems, secure lay-in panels with hold-down clips and protect over light fixtures, diffusers, air return grilles and other appurtenances according to ULC/UL design requirements.
 - .3 Wood Grille System: secure grille panels securely to grid using backer clip system.
- 3.5 COORDINATION

- .1 Coordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

3.6 INSPECTION AND CLEANING

- .1 Thoroughly inspect all ceiling tiles and remove any chipped, marked, scratched, stained, discoloured or otherwise damaged units, and replace with new units. Do not take replacement units from maintenance materials.
- .2 Thoroughly inspect all ceiling grid and remove any marked, scratched, dented or otherwise damaged pieces, and replace with new.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide resilient base and accessories.

1.3 REFERENCE STANDARDS

- .1 ASTM F1861; Specification for Resilient Wall Base.

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation

- .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.5 SUBMITTALS
 - .1 Samples: Submit duplicate 300mm long sample pieces of base, transition strips, and reducer strips in accordance with Section 01 30 00.
- 1.6 CLOSEOUT SUBMITTALS
 - .1 Maintenance Materials: Deliver the following material required for maintenance use, in accordance with Section 01 78 00;
 - .1 one carton of each colour and type resilient base,
 - .2 Maintenance Data: Provide maintenance data (cleaning requirements) for resilient base and accessories for incorporation into Operations and Maintenance manual.
- 1.7 SEQUENCING AND SCHEDULING
 - .1 Installation of resilient base and accessories shall not commence until all overhead mechanical, electrical, and dust-generating work is completed.
 - .2 Schedule resilient base installation for completion after installation of millwork.
- 1.8 ENVIRONMENTAL REQUIREMENTS
 - .1 Maintain air and substrate temperature in area of installation above 20°C for 48 hours before, during, and 48 hours after installation.

2 PRODUCTS

2.1 RESILIENT WALL BASE

- .1 Base for Resilient Flooring (RB-1): rubber, to ASTM F1861 Type TV, Group 1 (solid) resilient wall base, in continuous lengths of minimum (75ft) 23m.
 - .1 Height: (3") 76mm.
 - .2 Colours: as selected by Consultant from manufacturer's full available colour range.
 - .3 Critical Radiant Flux: Class 1, to ASTM E648.
 - .4 Flame/Smoke: Class A, 450 or less to ASTM E84.
 - .5 Acceptable Products

- .1 Johnsonite Millwork Oblique Wall Base, by Tarkett.
- .2 Base For Carpet (RB-2): rubber, to ASTM F1861 Type TV, Group 1 (solid), resilient wall base for carpet, in continuous lengths of minimum (75ft) 23m.
 - .1 Height: (3¼") 82mm.
 - .2 Colours: as selected by Consultant from manufacturer's full available colour range.
 - .3 Critical Radiant Flux: Class 1, to ASTM E648.
 - .4 Flame/Smoke: Class A, 450 or less to ASTM E84.
 - .5 Acceptable Products
 - .1 Johnsonite Tightlock Carpet Wall Base, by Tarkett.
- 2.2 STAIR NOSINGS
 - .1 Stair Nosings: rubber, surface type, one piece length per stair tread, with AODA-Compliant contrasting visually impaired tactile warning strips;
 - .1 Product: Tarkett No. VITSN.
 - .2 Colour/Pattern: as selected by Consultant.
- 2.3 ACCESSORIES
 - .1 Reducers
 - .1 Concrete to resilient floor: Tarkett No. CRS-XX-B.
 - .2 Colours: as selected by the Consultant.
- 2.4 ADHESIVES AND CLEANERS
 - .1 Primer: latex floor primer for concrete and wood substrates; equivalent to Henry #336 Floor Primer.
 - .2 Adhesives
 - .1 Wall Base:
 - .1 Porous Surfaces: equivalent to Tarkett #960 Cove Base Adhesive.
 - .2 Non-Porous Surfaces: equivalent to Tarkett #946 Premium Contact Adhesive.
 - .3 Surface Cleaner: neutral detergent solution.
- 3 EXECUTION**
- 3.1 BASE APPLICATION
 - .1 Supply and install wall base to minimize joints. Use minimum length materials specified, cut to wall lengths. Double cut all joints to ensure tight fit.
 - .2 Adhesive must cover 90% of back of base, leaving 6mm at top for excess adhesive during rolling process. Set base in adhesive tightly by using a 3kg hand roller, against wall and floor surfaces.
 - .3 Install base straight and level to variation of 1:1000.

- .4 Scribe and fit obstructions. Base shall be cut and discontinued at millwork. Base shall be shear cut at door frame reveals.
- .5 Cut and cope all inside corners. Cope back of base material using purpose-made coping tool and fold base around corner for all right angle outside corners. Use formed straight base material for outside corners of other angles.

3.2 ACCESSORIES APPLICATIONS

- .1 Install reducer strips at unprotected edges of all carpet and resilient flooring materials.

3.3 CLEANING AND PROTECTION OF FINISHED WORK

- .1 Remove excess adhesive from floor, base and wall surfaces without damage to such surfaces.
- .2 Clean all surfaces installed under this section with neutral detergent solution specified (85 to 113g/4.5L), to manufacturer's instructions.
- .3 Protect new base and accessories from time of installation until final waxing. Prohibit traffic on floor for 48 hours after installation.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide resilient sheet flooring including;
 - .1 floor preparation
 - .2 primers and sealers
 - .3 sheet flooring Products
 - .4 adhesives

1.3 REFERENCE STANDARDS

- .1 ASTM D2047; Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
- .2 ASTM E648; Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
- .3 ASTM E662; Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- .4 ASTM F970; Test Method for Static Load Limit.
- .5 ASTM F1859; Specification for Rubber Sheet Floor Covering without Backing

1.2 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents.

Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

1.4 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 30 00.
 - .2 Indicate on shop drawings a complete seaming layout for all resilient sheet products, colour and pattern layouts, types of adhesives and/or heat welding materials.
- .2 Samples
 - .1 Submit duplicate (8" x 10") 200mm x 250mm samples of all resilient sheet flooring materials, in specified colours and patterns, in accordance with Section 01 30 00.

1.5 CLOSEOUT SUBMITTALS

- .1 Maintenance Materials
 - .1 Deliver 2% of total area in one single piece, of each colour, pattern, and type flooring material required for project for maintenance use, in accordance with Section 01 78 00. Minimum maintenance materials shall be (100ft²)9.3m² of any one colour and/or floor type.
- .2 Maintenance Data

- .1 Provide care and maintenance data for resilient flooring for incorporation into Operations and Maintenance manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver sheet flooring products in rolls, wrapped in polyethylene. Store according to the manufacturer's recommendations.
- .2 Store materials flat on clean, dry floor area, away from construction activities so as to prevent damage.
- .3 Remove packaging prior to installation and allow materials to acclimatize according to the manufacturer's recommendations.

1.7 SEQUENCING AND SCHEDULING

- .1 Installation of resilient sheet flooring shall not commence until all overhead mechanical, electrical, and dust generating work is completed.
- .2 Schedule resilient sheet flooring installation for completion prior to installation of millwork.

1.8 SITE CONDITIONS

- .1 Maintain air temperature and structural base temperature at flooring installation area above (68°F)20°C for 72 hours before, during and 72 hours after installation. Temporary heat is not acceptable.

1.9 GUARANTEE

- .1 Guarantee in writing, the installation of the Products specified herein to be free from defects in workmanship for a period of two (2) years from Date of Substantial Performance.
- .2 This Guarantee shall cover instances of rippling, bubbling, seam failure, adhesive failure, and other installation defects which become apparent during the guarantee period, and are found to be due to faulty installation. The guarantee shall provide for repair of identified defects, including removal and replacement of any affected Products.

1.10 EXTENDED WARRANTY

- .1 Provide a warranty certificate in the name of the Owner, warranting that the Products specified herein shall be free from defects in material and manufacture for a period of five (5) years from Date of Substantial Performance.
- .2 This warranty shall provide for replacement of any defective Products at no cost to the Owner, including the cost of removal and disposal of

defective materials, and installation of new Products to match the original installation.

2 PRODUCTS

2.1 MATERIALS

.1 Resilient Sheet Flooring: sheet rubber, homogeneous to ASTM F1859 Type 1, three layer construction (rubber wear layer/60 Shore A rubber core/polyester backing), (0.079")2.0mm thickness, colour as selected by Consultant;

.1 Acceptable Products

.1 MONDO™ Harmoni™, by MONDO America Inc., Laval, QC.

2.1 ADHESIVES AND ACCESSORIES

.1 Substrate filler and leveler: Portland cement based latex filler requiring water only to produce cementitious paste, as recommended by flooring manufacturer for use with their product; equivalent to S-194/195 by Armstrong.

.2 Primer: latex floor primer for concrete and wood substrates; equivalent to S-185 by Armstrong.

.3 Moisture Retardant: for concrete and wood substrates; equivalent to S-135 VapArrest by Armstrong.

.4 Adhesives

.1 Rubber: two-part, solvent-free, polyurethane adhesive, equivalent to Johnsonite #975 Two-Part Urethane Adhesive.

.5 Welding Rods: colour and pattern matched welding rods, compatible with sheet flooring material, as supplied by individual flooring manufacturers.

.6 Surface Cleaner: neutral detergent solution.

.7 Surface Polish: matte finish commercial floor polish; Carefree Matte by Johnson Wax.

3 EXECUTION

3.1 INSPECTION

.1 Ensure concrete floors are dry by using test methods recommended by flooring manufacturer, and exhibit negative alkalinity, carbonization or dusting.

- .2 Moisture test results should meet the flooring manufacturer's recommendations but shall not exceed (5 lbs/1000ft²/24 hours) 0.5kg/100m²/24 hours. Alkali readings shall be 5 to 9.
- .3 If moisture content does not meet manufacturer's recommendations, apply moisture retardant to substrate, and re-test.

3.2 SUBFLOOR TREATMENT

- .1 Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with subfloor filler.
- .2 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .3 Prime entire substrate to receive tile flooring with specified primer, to primer manufacturer's recommendations.

3.3 FLOORING APPLICATION

- .1 Refer to Room Finish Schedule, Colour Schedule, and/or Floor Finishes Plans for locations of resilient sheet flooring types, and floor pattern requirements.
- .2 Apply adhesive uniformly using recommended trowel. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .3 Lay flooring with seams parallel to building lines and parallel to each other, to produce a minimum number of seams. "Piecing-in" with scrap or leftover material will not be accepted.
- .4 Double cut sheet joints and continuously seam seal heat weld according to manufacturer's printed instructions. Seams shall be in accordance with reviewed seaming layout. In the absence of a seaming layout, seam locations shall be as approved by Consultant on site prior to commencement of installation.
- .5 Run patterned sheets parallel to corridor traffic, and parallel to long dimension of rooms. Border widths minimum 1/3 width of full material width.
- .6 As installation progresses and after installation, roll flooring with (100 lb) 45kg roller to ensure full adhesion.
- .7 Cut flooring neatly around fixed objects. flooring shall run continuously under all millwork without interrupting floor pattern.

- .8 Install flooring in pan type floor access covers. Maintain floor pattern and direction.
 - .9 Continue flooring through areas to receive demountable partitions without interrupting floor pattern.
 - .10 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.
- 3.2 CLEANING AND POLISHING
- .1 Once cleaning and polishing operations commence, prohibit all traffic on floor surface during, and for a minimum 8 hours after cleaning and application of sealer and polish.
 - .2 Cleaning
 - .1 Remove excess adhesive from floor, base and wall surfaces without damage to such surfaces. Remove all dust, dirt, and debris.
 - .2 Clean floors with neutral detergent solution specified (3 to 4 oz/gal) 85 to 113g/4.5L, to flooring manufacturer's instructions.
 - .3 Final Surface Protection
 - .1 Apply final surface protection immediately prior to final inspection by the Consultant.
 - .2 Clean floors with neutral detergent solution specified (4 to 6 oz/gal) 113 to 170g/4.5L, to flooring manufacturer's instructions.
 - .3 Apply three coats of commercial floor polish specified.
- 3.3 PROTECTION OF FINISHED WORK
- .1 Protect new floors from scratches, gouges, scuff marks and other damage from time initial surface protection application, until final inspection.
 - .2 Prohibit all traffic on tile floor surfaces after application of final surface protection.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide resilient sheet flooring including
 - .1 Resilient sheet flooring.
 - .2 Adhesive and accessories required for installation.
 - .3 Flash cove base and accessories

1.3 REFERENCES

- .1 ASTM D2047: Standard Test Method for Static Coefficient of Friction of Floor Surfaces.
- .2 ASTM D2240: Standard Test Method for Rubber Property—Durometer Hardness.
- .3 ASTM D5116: Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.
- .4 ASTM E648: Standard Test Method for Critical Radial Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- .5 ASTM E662: Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- .6 ASTM E1745: Standard Specification for Water Vapour Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
- .7 ASTM F1869: Standard Test Method for Measuring Moisture Vapour Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

- .8 ASTM F2772; Standard Specification for Athletic Performance Properties of Indoor Sports Flooring Systems.
- .9 ASTM G21: Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .10 NFPA 101: Code for Safety to Life from Fire in Buildings and Structures.

1.4 SYSTEM DESCRIPTION

- .1 Provide a prefabricated athletic rubber flooring, dual durometer, vulcanized and calendared with a marbled pattern and hammered finish.
- .2 Provide athletic rubber flooring, which has been manufactured to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.5 SUBMITTALS

- .1 Make submittals in accordance with Section 01 30 00.
- .2 Submit Product data, including manufacturer's information for specified products, adhesive and line paint product data and manufacturer's certificate of approval for the proposed application.
- .3 Submit selection and verification samples for finishes, colours and textures.
- .4 Submit Shop drawings showing layout, profiles and product components.
- .5 Submit installation and maintenance instructions as published by the manufacturer.
- .6 Integral Base
 - .1 Submit duplicate (4" x 4") 102mm x 102mm samples of prefabricated flashcove bases in accordance with Section 01 30 00.
 - .2 Samples shall be representative of riser height and toe lengths specified, and shall represent one completed inside corner and one completed outside corner, with seams sealed and finished.
 - .3 Produce samples in specified flooring materials and selected colours.

1.6 MAINTENANCE MATERIALS

- .1 Maintenance Materials
 - .1 Deliver 2% of total area in one single piece, of each colour, pattern, and type flooring material required for project for maintenance use,

in accordance with Section 01 78 00. Minimum maintenance materials shall be (100ft²)9.3m² of any one colour and/or floor type.

- .2 Deliver 6.1m (20ft.) in 3.05m (10ft.) lengths, of prefabricated flashcove bases for each colour and type of flooring material used in the Work, for maintenance use in accordance with Section 01 78 00.

- .2 Maintenance Data

- .1 Provide care and maintenance data for resilient flooring for incorporation into Operations and Maintenance manual.
- .2 Provide care and maintenance data for prefabricated flashcove bases for incorporation into Operations and Maintenance manual.

- .3 Repair material must be from the same dye lot as material supplied for initial installation.

- .4 Maintain surface as per manufacturer's instructions.

1.7 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator

- .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

- .2 Installation/Application

- .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.

- .3 Documentation

- .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.

- .4 Pre-application Meeting

- .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)

- .4 Related Subcontractors whose work is affected by that of this Section.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Materials must be delivered in manufacturer's original, unopened and undamaged containers with identification labels intact.
- .2 Store material protected from exposure to harmful weather conditions, on a clean, dry, flat surface protected from all possible damage.
- .3 Recommended environmental condition for storage is a minimum of 13 deg C.
- .4 Material need not suffer excessive damage during handling (i.e. edge chipping, excessive warping etc).

1.9 SITE CONDITIONS

- .1 Maintain a stable room and subfloor temperature for a period of 48 hrs prior, during and 48 hrs after installation. Recommended range: 18 deg C to 27 deg C.
- .2 Installation to be carried-out no sooner than the specified curing time of concrete subfloor (normal density concrete curing time is approximately 28 days for development of design strength).
- .3 Moisture vapour emission content of the concrete slab must not exceed 3 lbs/1000 ft² per 24 hrs, when using the Calcium Chloride test as per ASTM F1869.

1.10 GUARANTEE

- .2 Guarantee in writing, the installation of the Products specified herein to be free from defects in workmanship for a period of two (2) years from Date of Substantial Performance.
- .3 This Guarantee shall cover instances of rippling, bubbling, seam failure, adhesive failure, and other installation defects which become apparent during the guarantee period, and are found to be due to faulty installation. The guarantee shall provide for repair of identified defects, including removal and replacement of any affected Products.

1.11 WARRANTY

- .1 Provide manufacturer's standard warranty. The athletic flooring is warranted to be free from manufacturing defects for a period of three (3) years from the Date of Substantial Performance.

2 PRODUCT

2.1 MATERIALS

- .1 **SSF.1 – Sheet Sports Flooring**
 - .1 Textured prefabricated impact resistant, athletic rubber flooring, calendared and vulcanized with a base of natural and synthetic rubber, stabilizing agents and pigmentation, manufactured in two layers, vulcanized together. The shore hardness of the top layer will be greater than that of the bottom layer; shore hardness of layers to be recommended by the manufacturer and the limits specified;
 - .1 Thickness: 8mm.
 - .2 Colour: Red Hots 10.
 - .3 Rolls: 1.22m wide and 7.6m length

- .2 Physical Properties
 - .1 Physical properties of the prefabricated athletic rubber floor, to conform to the following requirements:

Physical Properties	Standard	Specification
	ASTM F2772	Class 3
Hardness Shore A	ASTM D2240	80(±5)
Critical Radiant Flux	ASTM E648, NFPA 101	< 0.45 W/cm ² , Type I
Optical Density of Smoke	ASTM E662	< 450, Class I
Fungal Resistance	ASTM G21-90	No growth
Impact Resistance	EN 1517	> 8 N/m
Indentation Resistance	EN 1516	< 0.5mm
Coefficient of Friction	ASTM D2047	>0.90
V.O.C. Compliant	ASTM D5116	Yes

- .3 Acceptable Products
 - .1 Ecore EConights Sheet (8mm), by Ecore Commercial Flooring.
 - .2 Adhesives: Provide adhesive certified by the manufacturer; Low VOC Polyurethane Adhesive.
 - .1 Integral Base: Low-VOC premium cove base adhesive, as recommended by the prefabricated flashcove base manufacturer.
 - .3 Patching compound and line marking paint, to be supplied or approved/recommended by rubber athletic flooring manufacturer.

- .4 Pre-Fabricated Cove Bases: fabricated from same materials and dye lots as resilient flooring, in maximum practical lengths, with (1½" x 1½")38mm x 38mm formed aluminum reinforcing bonded to back of base material; as manufactured by FlashCove™ Prefabricated Bases Inc., Markham ON (800.334.5147), and as follows:
 - .1 Riser: (4")102mm.
 - .2 Toe: (3")76mm.
- .5 Metal Base Cap: for adhesive installation; stainless steel "chiklet" cap by FlashCove™ Prefabricated Bases Inc.
- .6 Seam Seal Adhesive: compatible with sheet flooring material, as supplied by individual flooring manufacturers.
- .7 Surface Cleaner: neutral detergent solution.

3 EXECUTION

3.1 EXAMINATION AND PREPARATION

- .1 The following must be ensured prior to installation:
 - .1 Concrete subfloors to be placed a minimum of thirty (30) days prior to the installation of athletic rubber floor.
 - .2 No concrete sealers or curing compounds are applied or mixed with the subfloors.
 - .3 Water vapor membrane complies with specification in ASTM E1745.
 - .4 Alkalinity test and moisture test must be preformed. PH level should be in the range of 7 to 8.5. Moisture content must not exceed 3 lbs/1000 ft² per 24 hrs (verify using the calcium chloride test as per ASTM F 1869).
 - .5 Subfloors must be clean, free of paint, dust, sealer, hardeners, grease, oil, solvents, old adhesive and any other foreign substances that may act as a bond barrier.
- .2 Sealing of cracks, holes and, smoothing and leveling of rough, uneven surfaces, must be carried out using a good quality Portland cement based leveling compound (feathering compound), approved by the manufacturer.
- .3 Report in writing to the Contractor & Consultant, any observed deficiencies requiring correction prior to commencement of installation.
- .4 Commencement of installation implies acceptance of surfaces and site conditions.

3.2 INSTALLATION

- .1 Review manufacturer's printed instructions prior to installation.
- .2 Install athletic flooring in accordance with manufacturer's Installation Instructions.
- .3 Unroll sheet and allow relaxation. Inspect sheet for any damages or defects.
- .4 Always install the flooring in the same direction.
- .5 Cut and adjust flooring prior to installation.
- .6 All edges must be straight-edged before adjusting the seams.
- .7 Mix adhesive in accordance with manufacturer's instructions. Apply adhesive and lay sheets in accordance with manufacturer's instructions.
- .8 Roll flooring in both directions with a 45 kg sectional floor roller. Check for air bubbles and continue rolling if needed.
- .9 Roll seams with a hand roller and remove any excess adhesive that may have come through.
- .10 Hold all seams in place with suitable weights (concrete utility bricks 50mm x 102mm x 203mm) for a minimum of 12 hrs.
- .11 Repeat the same procedure for the rest of the installation.
- .12 Allow adhesive to set 72 hrs before the initial cleaning of the surface.

3.3 INTEGRAL BASE APPLICATION

- .1 Provide pre-fabricated cove base for all integral base as indicated in finish schedules.
- .2 Dry-fit base; cut and fit material to required lengths. Mitre-cut inside and outside corners.
- .3 Dry-fit, and cut metal cove cap prior to base installation.
- .4 Scribe glue line on walls and floor at edge of base material.
- .5 Apply adhesive in full spread (100% coverage on two surfaces) for full length of base material. Apply base to wall surface straight and level.

- .6 Slide cove cap behind base material.
 - .7 Hand roll base material onto wall and floor surface, and remove all bumps, ripples, and fishmouths. Remove all excess adhesive.
 - .8 Seam seal all seams (vertical and horizontal) in base material.
- 3.4 CLEANING AND POLISHING
- .1 Once cleaning and polishing operations commence, prohibit all traffic on floor surface during, and for a minimum 8 hours after cleaning and application of sealer and polish.
 - .2 Cleaning (All flooring)
 - .1 Remove excess adhesive from floor, base and wall surfaces without damage to such surfaces. Remove all dust, dirt, and debris.
 - .2 Clean floors with neutral detergent solution specified (3 to 4 oz/gal) 85 to 113g/4.5L, to flooring manufacturer's instructions.
- 3.5 PROTECTION OF FINISHED WORK
- .1 Protect new floors from scratches, gouges, scuff marks and other damage from time initial surface protection application, until final inspection.
 - .3 Prohibit all traffic on tile floor surfaces after application of final surface protection.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide static dissipative tile flooring, including adhesives, primers, floor preparation and installation.

1.3 REFERENCES

- .1 ASTM E648; Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
- .2 ASTM E662; Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
- .3 ASTM F150; Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring
- .4 ASTM F710; Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
- .5 ASTM F1859; Specification for Rubber Sheet Floor Covering without Backing
- .6 ASTM F1869; Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
- .7 ASTM F2170; Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- .8 NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
- .9 NFPA 258 Standard Test Method for Measuring the Smoke Generated by Solid Materials.
- .10 ANSI/ESD S7.1 :Floor Materials-Resistive Characterization of Materials
- .11 ANSI/ESD STM 97.1: Floor Materials and Footwear-Resistance in Combination with a Person

- .12 ANSI/ESD STM 97.2: Floor Materials and Footwear Voltage Measurement in Combination with a Person
- .13 CAN/ULC-S102.2; Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.
- 1.4 **QUALITY ASSURANCE**
 - .1 **Manufacturer/Fabricator**
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .2 **Installation/Application**
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .3 **Documentation**
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
 - .4 **Pre-application Meeting**
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.5 **SAMPLES**
 - .1 Submit duplicate full sized tile samples of each type and colour of resilient tile specified in accordance with Section 01 30 00.
- 1.6 **DELIVERY, HANDLING AND STORAGE**
 - .1 Deliver products to the site in original, unopened containers with manufacturer's labels intact. Labels shall indicate product designation, lot numbers and colour.
 - .2 Store products in cool, dry, well-ventilated area at (50 to 81°F) 10 to 27°C, and away from any open flame, spark or other heat source.
- 1.7 **ENVIRONMENTAL REQUIREMENTS**
 - .1 Ambient air and surface temperature shall be (40 to 120°F) 4 to 50°C at installation area for 24 hours prior to and 24 hours after application.

- .2 Substrate temperature must be minimum (5°F) 3°C above dew point to prevent condensation.
- 1.8 SEQUENCING AND SCHEDULING
 - .1 Installation of resilient tile shall not commence until all overhead mechanical, electrical, and dust-generating work is completed.
 - .2 Schedule resilient tile installation for completion prior to installation of millwork.
- 1.9 CLOSEOUT SUBMITTALS
 - .1 Maintenance Data
 - .1 Provide data for maintenance of resilient flooring for incorporation into Operations and Maintenance Manual.
 - .2 Maintenance Materials
 - .1 Deliver 2% of total area of each colour, pattern and type tile flooring material required for this project for maintenance use, in accordance with Section 01 78 00. Minimum maintenance materials shall be (100ft²) 9.3m² of any one colour and/or floor type.

2 PRODUCTS

2.1 TILE MATERIALS

- .1 Static Dissipative Tile: homogeneous rubber to ASTM F1859 Type 1, three layer construction (rubber wear layer/60 Shore A rubber core/polyester backing), 3.5mm thickness, (39" x 39") 1000mm x 1000mm;
 - .1 Critical Radiant Flux: 0.45 watts/cm² – Class 1, to ASTM E648.
 - .2 Smoke: 450 or less to ASTM E662.
 - .3 Static Load Limit: (250 psi) 5.27 kg/cm² to ASTM F970.
 - .4 ANSI/ESD S7.1: 7.5 x 10⁸, 12% RH, tested surface to ground.
 - .5 Meets OSHA/NFPA (> 2.5 x 10⁴ ohms): 6.2 x 10⁷ ohms .
 - .6 Meets ASTM F150, 106 to 109 ohms (50% RH, 100v): 6.2 x 10⁷ ohms.
 - .7 ESD-approval (IEC 61340 / 100v): 107
 - .8 Colour: as selected by the Consultant.
 - .9 Acceptable Products are:
 - .1 Architectural SD Rubber Static Dissipative Tile, by StaticWorx ESD Flooring.
 - .2 ESD Rubber Static Dissipative Tile, by Roppe Corporation.

2.2 ADHESIVES AND ACCESSORIES

- .1 Substrate filler and leveler: Portland cement-based latex filler requiring water only to produce cementitious paste, as recommended by flooring manufacturer for use with their product.
- .2 Primer: latex floor primer for concrete and wood substrates.
- .3 Adhesive: equivalent to ASD-800 Static Dissipative Tile Adhesive by Roppe, or equivalent by StaticWorx.

- .4 Grounding Strips: (2") 50mm wide x (24") 610mm long copper ground-connection strips for under the tile.
- .5 Surface Cleaner: neutral detergent solution.

3 EXECUTION

3.1 INSPECTION

- .1 Ensure concrete floors are dry, by using test methods recommended by tile manufacturer, and exhibit negative alkalinity, carbonization or dusting.
- .2 Moisture test results should meet the flooring manufacturer's recommendations but shall not exceed (5 lbs/1000ft²) 0.5kg/100m² per 24 hours. Alkali readings shall be 5 to 9.
- .3 If moisture content does not meet manufacturer's recommendations, apply moisture retardant to substrate, and re-test.

3.2 SUBSTRATE TREATMENT

- .1 Remove substrate ridges and bumps. Fill low spots, cracks, joints, holes and other defects with filler.
- .2 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured.
- .3 Prime entire substrate to receive tile flooring with specified primer, to manufacturer's recommendations.

3.3 TILE APPLICATION

- .1 Apply adhesive uniformly using recommended notched trowel in strict accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .2 Install grounding strips to the requirements of the flooring manufacturer.
- .3 Lay flooring with joints parallel to building lines to produce symmetrical tile pattern. Border tiles shall be minimum half tile width.
- .4 As installation progresses, roll flooring with (100 lb.) 45kg roller to ensure full adhesion. Roll floor again in its entirety after installation.
- .5 Cut tile and fit neatly around fixed objects, and floor protrusions. Flooring shall run continuously under all millwork without interrupting floor pattern.
- .6 Install flooring in pan type floor access covers. Maintain floor pattern and direction.
- .7 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.

- .8 Install reducers at unprotected or exposed edges where flooring terminates, in accordance with Section 09 65 13.

3.4 CLEANING

- .1 Initial Surface Protection
 - .1 Apply initial surface protection within 48 hours after completion of installation and final set of adhesive. Prohibit all traffic on floor surface prior to application of initial surface protection.
 - .2 Remove excess adhesive from floor, base and wall surfaces without damage to such surfaces. Remove all dust, dirt, and debris.
 - .3 Clean floors with neutral detergent solution specified (3 to 4 oz/gal) 85 to 113g/4.5L, to flooring manufacturer's instructions.
- .2 Final Surface Protection
 - .1 Apply final surface protection immediately prior to final inspection by the Consultant.
 - .2 Clean floors with neutral detergent solution specified (4 to 6 oz/gal) 113 to 170g/4.5L, to flooring manufacturer's instructions.

3.5 PROTECTION OF FINISHED WORK

- .1 Protect new floors from scratches, gouges, scuff marks and other damage from time initial surface protection application, until final inspection.
- .2 Prohibit all traffic on floor surfaces after application of final surface protection.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide seamless epoxy flooring system.

1.3 REFERENCE STANDARDS

- .1 ASTM C579; Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
- .2 ASTM D4060; Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- .3 ASTM C413; Test Method for Water Absorption of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing.

1.4 SYSTEM DESCRIPTION

- .1 Chemical and abrasion-resistant, clear, two-coat epoxy seamless flooring.

1.5 SUBMITTALS

- .1 Samples
 - .1 Submit 300mm x 300mm colour/texture samples on plywood for verification purposes.
- .2 Product Data
 - .1 Submit manufacturer's product literature indicating product information correlated to the specific requirements.

1.6 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator

-
- .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
 - .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- .1 Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
 - .2 Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects. Store material per product data sheet.
 - .3 All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed.
- 1.8 PROJECT CONDITIONS
- .1 Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
 - .2 Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
 - .3 Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

- .4 Concrete substrate shall be properly cured. A vapor barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring
- 1.9 CLOSEOUT SUBMITTALS
 - .1 Submit copies of manufacturer's data for the care and maintenance of the epoxy flooring, for inclusion in the Operations and Maintenance manual.
- 1.10 EXTENDED WARRANTY
 - .1 Submit manufacturer's warranty certificate for the epoxy flooring, stating that the epoxy floor products specified herein will be free from defects in manufacture, and free of installation defects for a period of three (3) years from date of Substantial Performance.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Products specified herein are based on systems provided by Stonhard Canada. Equivalent Products and systems by one of the following that meet or exceed these specifications are acceptable:
 - .1 Sika Inc.
 - .2 General Polymers
 - .3 Euclid Chemical
 - .4 Or an approved equivalent.

2.2 SOURCE QUALITY CONTROL

- .1 Furnish certified statement signed by the Applicator and the flooring manufacturer/distributor, attesting that the materials furnished conform to the specified requirements, and that all fluid components are manufactured by a single company. Certificates shall be accompanied by laboratory test reports for the physical properties specified.

2.3 FLOORING SYSTEMS

- .1 **EPF-1 (Heavy Duty):** Stonclad GS®, or an approved equivalent.
 - .1 System Characteristics:
 - .1 Colour and Pattern: as selected by the Consultant from standard range of colours.
 - .2 Wearing Surface: Standard smooth.
 - .3 Integral Cove Base: troweled 100mm high cove base.
 - .4 Overall System Thickness: nominal 1/4".
 - .2 System Components: Manufacturer's standard components that are compatible with each other and as follows:
 - .1 Primer: 100 percent solids epoxy resin; Stonhard Standard Primer.
 - .1 Number of Coats: (1) one.
 - .2 Base: 100 percent solids epoxy resin; Stonkote GS4.
 - .1 Thickness of Coats: 4-6 Mil DFT.
 - .2 Number of Coats: (2) two.
 - .3 Mortar: 100 percent solids epoxy resin; Stonclad GS.
 - .1 Thickness of Coats: nominal 1/4 inch (6.4 mm).

- .2 Number of Coats: (1) One.
- .4 Aggregates: Quartz pigmented blended aggregate.
- .2 **EPF-2 (Light Duty):** Stonkote GS4®, or an approved equivalent.
 - .1 Low VOC, 100% solids, epoxy coating; with non-slip silica sand aggregate;
 - .2 System Characteristics:
 - .1 Colour and Pattern: as selected by the Consultant from standard range of colours.
 - .2 Wearing Surface: Standard smooth.
 - .3 Integral Cove Base: 100mm high cove base.
 - .4 Overall System Thickness: nominal 1/4".
 - .3 System Components: Manufacturer's standard components that are compatible with each other and as follows:
 - .1 Patching Mortar: Stonset PM5 epoxy.
 - .2 Base: 100 percent solids epoxy resin; Stonkote GS4.
 - .1 Thickness of Coats: 4-6 Mil DFT.
 - .2 Number of Coats: (2) two.
 - .3 Aggregate: silica sand.
- 2.4 **ACCESSORY MATERIALS**
 - .1 Patching, Leveling and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
 - .2 Joint Sealant: as supplied by flooring manufacturer for type of service and joint condition indicated. Stonflex MP7 joint fill material.
 - .3 Cove Cap: extruded aluminum cap strip with clear anodized finish.
- 3 EXECUTION**
- 3.1 **EXAMINATION**
 - .1 Before starting work, ensure environmental and site conditions are suitable for application and curing.
 - .2 Substrate shall be sound, dry, and free of dust, dirt, paint, grease, oil or other foreign substance.
 - .3 Variation in plane shall not exceed 1:350 in any measurement unit.
- 3.2 **PREPARATION**
 - .1 Prepare concrete slabs in accordance with manufacturer's instructions.
 - .2 Effectively remove concrete laitance by steel shot blasting, or other mechanical means approved by topping manufacturer to provide an 200-250 micron profile. Vacuum surface to remove all dust and debris.

- .3 Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
- .4 Mechanically prepare substrates as follows:
 - .1 Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
- .5 Verify that concrete substrates meet the following requirements:
 - .1 Perform in situ probe test, ASTM F2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 85 percent.
 - .2 Perform anhydrous calcium chloride test, ASTM F1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab in 24 hours.
 - .3 Contractor to coordinate with installer and manufacturer after 28 days to ensure concrete slab meets install requirements.
- .6 Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- .7 Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations. Allowances should be included for Stonflex MP7 joint fill material, and CT5 concrete crack treatment.

3.3 APPLICATION

- .1 General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - .1 Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 - .2 Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 - .3 At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
 - .1 Apply joint sealant to comply with manufacturer's written recommendations.
- .2 Apply primer where required by resinous system, over prepared substrate at manufacturer's recommended spreading rate.
- .3 Integral Cove Base (Where Indicated): Stonclad GR mortar, apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, of cove base. Round internal and external corners.
 - .1 Integral Cove Base: 102mm high.

- .4 Apply metal trowel single mortar coat in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.
 - .5 Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.
- 3.4 TERMINATIONS
- .1 Chase edges to “lock” the flooring system into the concrete substrate along lines of termination.
 - .2 Penetration Treatment: Lap and seal resinous system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.
 - .3 Trenches: Continue flooring system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.
 - .4 Treat floor drains by chasing the flooring system to lock in place at point of termination.
- 3.5 JOINTS AND CRACKS
- .1 Treat control joints to bridge potential cracks and to maintain monolithic protection.
 - .2 Treat cold joints and construction joints and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.
 - .3 Vertical and horizontal contraction and expansion joints are treated by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.
- 3.6 CLEANING, PROTECTING, AND CURING
- .1 Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.
 - .2 Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection.
 - .3 Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer. General contractor is responsible for cleaning prior to inspection.

3.7 FIELD QUALITY CONTROL

- .1 Manufacturer shall have a qualified technical field representative on site prior to commencement of installation, and present at commencement of all system coats.
- .2 Finished application shall match approved samples, be uniform in thickness, sheen, colour and texture, and free from trowel marks, visible cold joints and defects affecting appearance or performance.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.3 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide carpet tile floor finish, including primers, mastics and leveling fillers, adhesives, carpet tile material, accessories, and protection.

1.4 REFERENCES

- .1 CAN/CGSB-4.2; Textile Test Methods.
- .2 CAN/CGSB-4.129; Carpets for Commercial Use.
- .3 CAN/CGSB-25.20; Surface Sealer Floors.
- .4 CAN/ULC-S102; Surface Burning Characteristics of Building Materials and Assemblies.
- .5 CAN/ULC-S102.2; Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.
- .6 Carpet and Rug Institute (CRI) - Contract Carpet Manual, No.001.
- .7 Carpet and Rug Institute (CRI) - IAQ Carpet Testing Program.
- .8 ASTM E84; Test Method for Surface Burning Characteristics of Building Materials.

1.5 QUALITY ASSURANCE

- .1 Installer shall have a minimum of five (5) years documented experience in the installation of commercial carpet, and be a certified by the Manufacturer. Documentation shall be submitted to the Consultant.

1.6 MOCK-UP

- .1 Construct a (10ft x 10ft) 3mx3m mock-up of typical carpet tile flooring installation, in place including base and all specified materials.

- .2 Have Consultant review and approve mock-up before proceeding. If approved mock-up shall serve as the minimum standard of work for the entire project.

1.7 SUBMITTALS

- .1 Submit control submittals in accordance with Section 01 30 00.
- .2 Submit certificate to demonstrate compliance with CAN/ULC S102 and CAN/ULC S102.2.
- .3 Submit proof that carpet has been tested and passed the Indoor Air Quality (IAQ) Carpet Testing Program requirements of the Carpet and Rug Institute.
- .4 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning and repair procedures.
- .5 Product Data
 - .1 Submit product data in accordance with Section 01 30 00.
 - .2 Submit product data sheet for carpet tile, adhesive, carpet protection and subfloor filler.
 - .3 Submit WHMIS MSDS - Material Safety Data Sheets acceptable to Labour Canada and Health and Welfare Canada for carpet adhesive and seam adhesive. Indicate VOC content.
- .6 Samples
 - .1 Submit samples in accordance with Section 01 30 00.
 - .2 Submit duplicate full size pieces of each type carpet tile, duplicate pieces for each colour selected.
- .7 Closeout Submittals
 - .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00.
 - .2 Include information on recycling of carpet including manufacturer's reprocessing program. Indicate which portions of materials are recyclable.
- .8 Extra Materials
 - .1 Provide extra materials of carpet tile and adhesives in accordance with Section 01 78 00.
 - .2 Provide minimum 2% of each colour, pattern and type of carpet tile, in new, full, unopened cartons. Round up to quantity to next full carton.

- .3 Extra materials to be from same production run as installed materials.
- .4 Identify each package of carpet tile and each container of adhesive.
- .5 Deliver and store where directed by Consultant.

1.8 REGULATORY REQUIREMENTS

- .1 Prequalification: tested to CAN/ULC-S102.2.
- .2 Indoor Air Quality: compliance with CRI Indoor Air Quality Program, CRI - IAQ requirements for maximum total volatile chemicals released into air. Label each carpet product with CRI -IAQ label.

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Label packaged materials. For tile products indicate nominal dimensions of tile.
- .2 Store packaged materials in original containers or wrapping with manufacturer's seals and labels intact.
- .3 Store carpet tile and accessories in location as directed by Consultant.
- .4 Prevent damage to materials during handling and storage. Keep materials under cover and free from dampness.
- .5 Maintain temperature of storeroom at a minimum of 20°C, for at least 24 hours immediately before the installation.

1.10 PROJECT/SITE ENVIRONMENTAL REQUIREMENTS

- .1 Moisture: Ensure substrate is within moisture limits prescribed by manufacturer.
- .2 Temperature: Maintain ambient temperature of not less than 18°C from 72 hours before installation to at least 72 hours after completion of work.
- .3 Relative humidity: Maintain relative humidity between 10 and 65% RH for 48 hours before, during and 48 hours after installation.
- .4 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

1.11 VENTILATION

- .1 Ventilate area of work as directed by Consultant by use of approved portable supply and exhaust fans.
- .2 Ventilate enclosed spaces in accordance with Section 01 50 00.

- .3 Provide continuous ventilation during and after carpet application. Run ventilation system 24 hours per day during installation; provide continuous ventilation for 7 days after completion of carpet installation.

1.12 EXTENDED WARRANTIES

- .1 System Warranty
 - .1 Provide manufacturer's certificate warranting the specified carpet products against defects in materials and manufacture including deterioration of backing, delamination, stretching, wrinkling, fading, or other conditions detrimental to appearance or performance, for a minimum period of 10 years from Date of Substantial Performance. Warranty shall cover complete replacement of affected area including carpet, adhesives, and removal/installation costs.
- .2 Installation Warranty
 - .1 Provide a written guarantee stating that carpet installation is guaranteed against defects for two (2) years from Date of Substantial Performance.

2 PRODUCTS

2.1 MATERIALS

- .1 Carpet Tile:
 - .1 Size: 500mm x 500mm
 - .2 Pattern/Collection: Icebreaker.
 - .3 Style: 1473002500.
 - .4 Colour: as selected by the Consultant.
 - .5 Supplier: Interface Flooring.
 - .6 Install pattern: ¼ turn.

2.2 ACCESSORIES

- .1 Adhesive: Acrylic release type: recommended by carpet tile manufacturer; Low VOC content in accordance with CRI requirements.
- .2 Carpet protection: non-staining heavy-duty kraft paper, or cardboard.
- .3 Concrete Floor Sealer/Moisture Barrier: Planiseal™ MRB, by Mapei.
- .4 Subfloor Filler & Patch: Portland cement based, premix latex requiring only water to produce cementitious paste; "Planipatch®" by Mapei.

3 EXECUTION

3.1 EXAMINATION

- .1 Examine substrates for defects and determine level of preparation required prior to commencement of installation.
- .2 Report any major defects such as cracks greater than 1.5mm in width, and variations in elevation greater than 6mm in 3m in any direction or excessive moisture content in concrete slabs.

- .3 Ensure concrete floors are dry by using test methods recommended by flooring manufacturer, and exhibit negative alkalinity, carbonization or dusting.
- .4 Moisture test results shall meet or exceed the flooring manufacturer's warranty requirements but in no instance shall exceed $0.4\text{kg}/100\text{m}^2/24$ hours. Alkali readings shall be 5 to 9.

3.2 PREPARATION

- .1 Remove ridges and bumps.
- .2 Apply sub-floor filler/patch to low spots and cracks to achieve floor level to a tolerance of 1:500. Allow to cure.
- .3 Where moisture tests result in values higher than those specified above, apply floor sealer/moisture barrier to concrete floor surface prior to installation. Re-test moisture levels.
- .4 Prepare floor surfaces in accordance with Contract Carpet Manual, Standard for Installation of Textile Floorcovering Materials No.001.
- .5 Pre-condition carpet tile following manufacturer's printed instructions.
- .6 Install base before proceeding with carpet tile.

3.3 INSTALLATION

- .1 Install in accordance with manufacturer's printed instructions and in accordance with Contract Carpet Manual, Standard for Installation of Textile Floorcovering Materials No.001.
- .2 Install carpet after finishing work is completed but before demountable office partitions and telephone and electrical pedestal outlets are installed.
- .3 Finish installation to present smooth wearing surface free from conspicuous burring and other faults.
- .4 Use material from same dye lot. Ensure colour, pattern and texture match within any one visual area.
- .5 Cut and fit neatly around architectural, mechanical, electrical and telephone outlets, and furniture fitments, around perimeter of rooms into recesses, and around projections.
- .6 Cut and install carpet tile in pan type floor access covers.
- .7 Carpet Tile
 - .1 Apply acrylic release type adhesive and install carpet tile in accordance with manufacturer's written instructions.
 - .2 Lay tiles with butt seams.

- .3 Lay tile in pattern as in 2.1.1.6 above.
- 3.4 PROTECTION OF FINISHED WORK
 - .1 Vacuum carpet clean immediately after completion of installation. Protect traffic areas.
 - .2 Prohibit traffic on carpet until adhesive is cured. Install carpet protection to satisfaction of Consultant.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to cover with paint the surfaces of the building or structure, and the building services and accessories not otherwise protected or covered, to the full intent of the drawings and specifications.
- .2 Surface preparation of substrates to receive painting and finishing is included in this section of work.
- .3 This section of work shall include the painting and finishing of all exposed surfaces of the following substrates:
 - .1 Steel (Prime painted)
 - .2 Steel (Galvanized)

1.3 REFERENCE STANDARDS

- .1 CAN2-85.100, National Standards of Canada, Painting.
- .2 Master Painters Institute (MPI) Architectural Painting Specification Manual.

1.4 MATERIALS AND EQUIPMENT NOT TO BE PAINTED

- .1 Surfaces not to be painted shall be left completely free of droppings, overspray, or accidentally applied materials resulting from the work of this Section.

- .2 Items not to be painted include concealed structural elements, and equipment furnished with complete factory-applied, coloured paints and finish systems.
- 1.5 COOPERATION WITH OTHER TRADES
 - .1 Schedule and coordinate this work with other trades and do not proceed until other work and/or job conditions are as required to achieve satisfactory results.
 - .2 Examine all specification sections for materials and products, and become thoroughly familiar with all provisions regarding painting.
- 1.6 QUALITY ASSURANCE
 - .1 Material Manufacturers
 - .1 All paint and finish products shall be those listed in the Approved Products List of the MPI manual, latest edition unless otherwise specified or listed herein.
 - .2 Applicators
 - .1 The painting subcontractor shall have a minimum of five (5) years documented experience in commercial painting and finishing, and shall maintain a qualified crew of size necessary to fully satisfy the requirements of this section.
 - .3 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturers and/or Distributors (Technical Representatives)
 - .4 Related Subcontractors (ie. Mechanical and/or Electrical)
 - .5 Consultant
- 1.7 MOCK-UP REQUIREMENTS
 - .1 Finish one complete exterior element of each colour scheme required, showing selected materials, colours and textures. Have Consultant review mock-up for acceptance of colour and finish, prior to ordering of materials for further work.
 - .2 Consultant reserves the right to change colour and/or finish selection upon review of mock-up, if deemed unacceptable.
 - .3 Refinish rejected areas until acceptance is achieved.
 - .4 Once approved by the Consultant, mock-ups shall serve as the minimum acceptable standard for similar work throughout the Project.
- 1.8 COLOUR SCHEDULE

- .1 The Consultant will prepare a colour schedule as the job progresses. The final selection of colours and surface textures of all finishes throughout shall rest solely with the Consultant.
- 1.9 COMPLETION SCHEDULE
- .1 Furnish the Consultant with a schedule showing expected completion of the respective coats of paint for the various areas and surfaces. Keep this schedule current as the job progresses.
- 1.10 SUBMITTALS
- .1 Product Codes
 - .1 Submit a complete list of product codes from the manufacturer(s) proposed for use on this project, for all Products listed in finish systems specified herein, in accordance with Section 01 30 00.
 - .2 Samples
 - .1 Submit samples of all finishes specified herein, in accordance with Section 01 30 00.
 - .2 Submit duplicate (8" x 12") 200 x 300mm sample panels of each type of paint and finish application for approval by the Consultant.
 - .3 Where manufacturer of paint differs from that listed in the colour schedule, employ spectrograph technology to ensure accurate colour match. Selection of the "next nearest colour" by another manufacturer will not be acceptable.
 - .4 Finished work to match approved samples.
- 1.11 DELIVERY, STORAGE AND HANDLING
- .1 Paint and finish materials shall be delivered to the site in sealed original labelled containers bearing manufacturer's name, type of paint, brand name, colour designation and instructions for mixing and/or reducing.
 - .2 Store materials in a heated, dry, well-ventilated, indoor place having a minimum ambient temperature of (45°F) 7°C.
 - .3 Keep waste rags in metal drums and remove all rags, waste and trash from the building at the end of each working shift.
 - .4 Provide CO₂ fire extinguisher of minimum (20 lb) 9kg capacity in storage area.
 - .5 Ensure that health and fire regulations are complied with in storage area.
- 1.12 GENERAL COLOUR REQUIREMENTS
- .1 Refer to the Drawings and Schedules for types and extent of finishes, and to the Colour Schedule for individual colour and gloss/sheen selections.

- .2 Where manufacturer of paint differs from that listed in the colour schedule, employ spectrograph technology to ensure accurate colour match. Selection of the "next nearest colour" by another manufacturer will not be acceptable.

1.13 ENVIRONMENTAL CONDITIONS

- .1 Temperatures: No painting shall be performed when substrate or ambient air temperatures are below (41°F) 5°C. Minimum allowable temperatures for application of Latex paints are (50°F) 10°C (exterior work).
- .2 Relative humidity: shall not exceed 85%.
- .3 Moisture content of substrates: Masonry and concrete materials shall be allowed to cure for a minimum of 28 days before application of paints. Substrates shall be measured by electronic moisture meter, to the following maximums:
 - .1 Masonry, concrete/concrete block: 12% for solvent based paints.
 - .2 Wood: 15%.
- .4 Lighting: Painting shall not proceed unless a minimum of (15 cd/ft²) 1.3 lx lighting is provided on the surfaces to be painted.
- .5 Ventilation: All areas where painting is proceeding require adequate continuous ventilation and sufficient heating facilities to maintain temperatures above (45°F) 7°C for 24 hours before during and after paint application.

1.14 MAINTENANCE MATERIALS

- .1 Supply Owner with one clearly identified, new and unopened gallon of each colour and type of paint, stain and varnish used for this work, in accordance with Section 01 78 00.
- .2 All colour mixing codes must be clearly labeled, and colour numbers (P1, P2, etc.) must be marked on the container.

1.15 EXTENDED WARRANTY

- .1 Provide upon completion of the work, a Warranty Certificate, in the name of the Owner, stating that the work of this section was performed in accordance with these specifications and the MPI manual (latest edition), and is warranted against defects in material or installation, for a period of two (2) years from Date of Substantial Performance.

2 PRODUCTS

2.1 MATERIALS

- .1 Paint, varnish, stain, enamel, lacquer and fillers shall be of a type and brand herein specified and/or listed under Chapter 5 (Approved Products List) of the MPI manual.

- .2 Paint materials such as linseed oil, shellac, turpentine, and any materials not specified herein but required for first class work with the finish specified shall be the highest quality product of an approved manufacturer. All materials shall be compatible with finish paint or coating materials.

2.2 MIXING

- .1 Paints shall be ready-mixed unless otherwise specified, except that any coating in paste or powder form, or to field-catalyzed shall be field-mixed in accordance with the directions of its manufacturer. Pigments shall be fully ground and shall maintain a soft paste consistency in the vehicle during storage that can and shall be dispersed readily and uniformly by paddle to a complete homogeneous mixture.
- .2 The paint shall have good flow and brush properties and shall dry or cure free of sags or runs to yield the desired finish specified.

2.3 GLOSS LEVELS

.1 MPI Gloss and Sheen Levels;	<u>Gloss @60°</u>	<u>Sheen @85°</u>
Level G1 – (Flat):	max. 5	max. 10.
Level G2 – (Velvet):	max. 10	10-35.
Level G3 – (Eggshell):	10-25	10-35.
Level G4 – (Satin):	20-35	min.35.
Level G5 – (Semi-Gloss):	35-70.	
Level G6 – (Gloss):	70-85.	
Level G7 – (High Gloss):	>85.	

3 EXECUTION

3.1 INSPECTION OF SURFACES

- .1 Examine surfaces to receive paint finishes for defects which cannot be corrected by procedures specified herein, and which may result in unsatisfactory paint finishes. Report items to the Consultant and the Contractor in writing, prior to commencement of work of this section, or after initial prime coat shows defects in substrate.
- .2 The application of subsequent prime and finish coats shall be construed as acceptance of the surfaces, and thereafter this subcontractor shall be fully responsible for satisfactory work as required herein.

3.2 PREPARATION OF SURFACES

- .1 Refer to the MPI manual Chapter 3 for surface preparations not specified in this section.

3.3 PROTECTION

- .1 Protect all adjacent surfaces from paint and damage resulting from the work of this section, and make good any damage caused by failure to provide such protection.

- .2 Mask all adjacent finishes and surfaces with masking tape as required. Remove tape promptly after final finish coat has been applied and allowed to dry.
- .3 Furnish sufficient drop cloths, shields and protective equipment to prevent spray or dropping from fouling surfaces not being painted or where painting has been completed.
- .4 Cotton waste, cloths and material, which may constitute a fire hazard, shall be placed in closed metal containers and removed daily from the site.
- .5 Remove and protect, prior to painting operations, all hardware, accessories, device plates, lighting fixtures, factory finished work, and similar items, or provide ample in-place protection such as masking tape. If removed, these items shall be labelled, stored, cleaned if necessary and re-installed following successful completion of the work in each area. Solvents detrimental to lacquer finishes are not to be used for cleaning these items.

3.4 APPLICATION

- .1 Apply paints and coatings by currently accepted trade methods.
- .2 Painting coats specified are intended to cover surfaces satisfactorily when applied in strict accordance with manufacturer's recommendations. Where proper coverage has not been attained, the Consultant may ask for additional coats as required, at no additional cost.
- .3 Apply each coat at the proper consistency. Sand lightly between coats.
- .4 Tint primers to same colour range as finish coats.
- .5 Do not apply finishes on surfaces that are not sufficiently dry. Each coat of finish should be dry and hard before a following coat is applied unless specified otherwise by the manufacturer.
- .6 Spraying of paint on exterior surfaces is strictly prohibited, unless specified herein, or as approved by the Consultant.
- .7 Provide complete coverage and hide. When colour, stain, dirt or undercoats show through final coat of paint, provide additional coats until the paint film is of uniform finish, colour, appearance and coverage, at no additional cost to the Owner.
- .8 Allow all coats to dry to manufacturer's recommendations before applying succeeding coats.
- .9 Touch up all suction spots or "hot spots" in concrete after the application of the first coat, before applying the second coat.

- .10 Barricade areas where finishing is in progress to prevent traffic or other activities, and otherwise protect work until dry. Post "Wet Paint" signs and remove when no longer required.
 - .11 Replace at the expense of this section, materials soiled or damaged by finishing materials which cannot be removed.
- 3.5 PAINTING AND FINISHING OF EXISTING MATERIALS AND SURFACES
- .1 Remove, label and store, prior to re-painting of existing materials and surfaces the following items:
 - .1 Door hardware, and signage,
 - .2 Factory finished work,
 - .3 Signage where removable.
 - .2 Where such items are not removable, provide proper masking and protection prior to commencement of painting:
 - .3 Clean such items if deemed necessary by the Consultant, before being re-installed following successful completion of the work in each area. Solvents detrimental to lacquer finishes are not to be used for cleaning these items.
- 3.6 CLEAN-UP
- .1 Upon completion of the work, remove all paint and varnish spots from floors, glass and other surfaces. Remove from the premises all rubbish and accumulated materials of whatever nature, not caused by others, and leave this work in clean, orderly and acceptable conditions.
- 3.7 PAINTING AND FINISHING SCHEDULE
- .1 The following titles and code numbers refer to Chapter 2 of the MPI Manual, unless otherwise indicated for type of coating, grade, named products and their manufacturers.
 - .2 Exterior Painting & Finishing
 - .1 Metal Finishing Systems
 - .1 Non Fire-Rated Structural & Miscellaneous Steel (Shop-primed).
 - .1 High Performance Polyurethane Finish (2-component Epoxy / Polyurethane). Refer to Section 09 97 13.23.
 - .2 Galvanized Metals (not chromate passivated) – High Contact (Doors frames, railings balustrades, etc.) Premium Grade Finish.
 - .1 EXT. 5.3B; Alkyd (over cementitious primer), Gloss/Sheen – G5.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to cover with paint the interior surfaces of the building or structure, and the building services and accessories not otherwise protected or covered, to the full intent of the drawings and specifications.
- .2 Surface preparation of substrates to receive painting and finishing is included in this section of work.
- .3 This section of work shall include the painting and finishing of all exposed surfaces of the following substrates:
 - .1 Wood
 - .2 Steel (Prime-painted & Galvanized)
 - .3 Concrete
 - .4 Masonry
 - .5 Plaster / gypsum board surfaces
 - .6 Steel overhead doors & frames
 - .7 Exposed Mechanical and Electrical equipment (Conduit, Piping, Ductwork, etc. Including hangers)

1.3 REFERENCE STANDARDS

- .1 CAN2-85.100, National Standards of Canada, Painting.
- .2 Master Painters Institute (MPI) Architectural Painting Specification Manual.

- 1.4 MATERIALS AND EQUIPMENT NOT TO BE PAINTED
 - .1 Surfaces not to be painted shall be left completely free of droppings, over-spray, or accidentally applied materials resulting from the work of this Section.
 - .2 Items not to be painted include concealed structural elements, and equipment furnished with complete factory-applied, coloured paints and finish systems.
- 1.5 COOPERATION WITH OTHER TRADES
 - .1 Schedule and coordinate this work with other trades and do not proceed until other work and/or job conditions are as required to achieve satisfactory results.
 - .2 Examine all specification sections for materials and products, and become thoroughly familiar with all provisions regarding painting.
- 1.6 QUALITY ASSURANCE
 - .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
 - .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.7 MOCK-UP REQUIREMENTS

- .1 Finish one complete room of each colour scheme required, showing selected materials, colours and textures. Have Consultant review mock-up for acceptance of colour and finish, prior to ordering of materials for further work.
 - .2 Consultant reserves the right to change colour and/or finish selection upon review of mock-up, if deemed unacceptable.
 - .3 Refinish rejected areas until acceptance is achieved.
 - .4 Once approved by the Consultant, mock-ups shall serve as the minimum acceptable standard for similar work throughout the Project.
- 1.8 COLOUR SCHEDULE
- .1 The Consultant will prepare a colour schedule as the job progresses. The final selection of colours and surface textures of all finishes throughout shall rest solely with the Consultant.
- 1.9 COMPLETION SCHEDULE
- .1 Furnish the Consultant with a schedule showing expected completion of the respective coats of paint for the various areas and surfaces. Keep this schedule current as the job progresses.
- 1.10 SUBMITTALS
- .1 Product Codes
 - .1 Submit a complete list of product codes from the manufacturer(s) proposed for use on this project, for all products listed in finish systems specified herein, in accordance with Section 01 30 00.
 - .2 Samples
 - .1 Submit samples of all paints and finishes specified herein, in accordance with Section 01 30 00.
 - .2 Submit duplicate (8" x 12") 200 x 300mm sample panels of each type of paint and finish application for approval by the Consultant.
 - .3 Where manufacturer of paint differs from that listed in the colour schedule, employ spectrograph technology to ensure accurate colour match. Selection of the "next nearest colour" by another manufacturer will not be acceptable.
 - .4 Use birch plywood for wood finishes, gypsum board for paint finishes over smooth surfaces. Refer to Mock-up Requirements for masonry finishes.
 - .5 Finished work to match approved samples.
 - .6 The Consultant reserves the right to alter colour selections following sample review.

1.11 DELIVERY, STORAGE AND HANDLING

- .1 Paint and finish materials shall be delivered to the site in sealed original labelled containers bearing manufacturer's name, type of paint, brand name, colour designation and instructions for mixing and/or reducing.
- .2 Store materials in a heated, dry, well-ventilated, indoor place having a minimum ambient temperature of (45°F) 7°C.
- .3 Keep waste rags in metal drums and remove all rags, waste and trash from the building at the end of each working shift.
- .4 Provide CO₂ fire extinguisher of minimum (20 lb) 9kg capacity in storage area.
- .5 Ensure that health and fire regulations are complied with in storage area.

1.12 GENERAL COLOUR REQUIREMENTS

- .1 Refer to the Room Finish Schedule for type and extent of finishes, and to the Colour Schedule for individual colour and sheen selections.
- .2 Where manufacturer of paint differs from that listed in the colour schedule, employ spectrograph technology to ensure accurate colour match. Selection of the "next nearest colour" by another manufacturer will not be acceptable.
- .3 The following, generally, will be painted colour, and sheen to match adjacent surfaces
 - .1 Access doors
 - .2 Exposed piping, conduit and ductwork
- .4 The following major items, generally, will be painted the same colour throughout the Work, but different colours from each other:
 - .1 Doors and door frames
 - .2 Ceilings
 - .3 Walls
 - .4 Railings and balustrades
 - .5 Exposed structural members and deck
- .5 This subcontractor shall base their bid price on:
 - .1 8 different colour schemes for the painting of rooms.
 - .2 4 different colour schemes for the painting of doors and frames.

1.13 ENVIRONMENTAL CONDITIONS

- .1 Temperatures: No painting shall be performed when substrate or ambient air temperatures are below (41°F) 5°C. Minimum allowable temperature for application of Latex paints is (45°F) 7°C.
- .2 Relative humidity: shall not exceed 85%.

- .3 Moisture content of substrates: Masonry and concrete materials shall be allowed to cure for a minimum of 28 days before application of paints. Substrates shall be measured by electronic moisture meter, to the following maximums:
 - .1 Plaster and Gypsum board: 12%.
 - .2 Masonry, concrete/concrete block: 12% for solvent based paints.
 - .3 Wood: 15%.
 - .4 Lighting: Painting shall not proceed unless a minimum of (15 cd/ft²) 1.3 lx lighting is provided on the surfaces to be painted.
 - .5 Ventilation: All areas where painting is proceeding require adequate continuous ventilation and sufficient heating facilities to maintain temperatures above (45°F) 7°C for 24 hours before during and after paint application.
- 1.14 MAINTENANCE MATERIALS
- .1 Supply Owner with one clearly identified, new and unopened gallon of each colour and type of paint, stain and varnish used for this work, in accordance with Section 01 78 00.
 - .2 All colour mixing codes must be clearly labeled, and colour numbers (P1, P2, etc.) must be marked on the container.
- 1.15 EXTENDED WARRANTY
- .1 Provide upon completion of the work, a Warranty Certificate, in the name of the Owner, stating that the work of this section was performed in accordance with these specifications and the MPI manual (latest edition), and is warranted against defects in material or installation, for a period of two (2) years from Date of Substantial Performance.

2 PRODUCTS

2.1 MATERIALS

- .1 Paint, varnish, stain, enamel, lacquer and fillers shall be of a type and brand herein specified and/or listed under Chapter 5 (Approved Products List) of the MPI manual.
- .2 Paint materials such as linseed oil, shellac, turpentine, and any materials not specified herein but required for first class work with the finish specified shall be the highest quality product of an approved manufacturer. All materials shall be compatible with finish paint or coating materials.

2.2 MIXING

- .1 Paints shall be ready-mixed unless otherwise specified, except that any coating in paste or powder form, or to field-catalyzed shall be field-mixed in accordance with the directions of its manufacturer. Pigments shall be fully ground and shall maintain a soft paste consistency in the vehicle during storage that can and shall be dispersed readily and uniformly by paddle to a complete homogeneous mixture.
- .2 The paint shall have good flow and brush properties and shall dry or cure free of sags or runs to yield the desired finish specified.

2.3 GLOSS LEVELS

.1 MPI Gloss and Sheen Levels;	<u>Gloss @60°</u>	<u>Sheen @85°</u>
Level G1 – (Flat):	max. 5	max. 10.
Level G2 – (Velvet):	max. 10	10-35.
Level G3 – (Eggshell):	10-25	10-35.
Level G4 – (Satin):	20-35	min.35.
Level G5 – (Semi-Gloss):	35-70.	
Level G6 – (Gloss):	70-85.	
Level G7 – (High Gloss):)85.	

3 EXECUTION

3.1 INSPECTION OF SURFACES

- .1 Examine surfaces to receive paint finishes for defects which cannot be corrected by procedures specified herein, and which may result in unsatisfactory paint finishes. Report items to the Consultant and the Contractor in writing, prior to commencement of work of this section, or after initial prime coat shows defects in substrate.
- .2 The application of subsequent prime and finish coats shall be construed as acceptance of the surfaces, and thereafter this subcontractor shall be fully responsible for satisfactory work as required herein.

3.2 PREPARATION OF SURFACES

- .1 Refer to the MPI manual Chapter 3 for surface preparations not specified in this section.

3.3 PROTECTION

- .1 Protect all adjacent surfaces from paint and damage resulting from the work of this section, and make good any damage caused by failure to provide such protection.
- .2 Mask all adjacent finishes and surfaces with masking tape as required. Remove tape promptly after final finish coat has been applied and allowed to dry.

- .3 Furnish sufficient drop cloths, shields and protective equipment to prevent spray or dropping from fouling surfaces not being painted or where painting has been completed.
- .4 Cotton waste, cloths and material, which may constitute a fire hazard, shall be placed in closed metal containers and removed daily from the site.
- .5 Remove and protect, prior to painting operations, all hardware, accessories, device plates, lighting fixtures, factory finished work, and similar items, or provide ample in-place protection such as masking tape. If removed, these items shall be labelled, stored, cleaned if necessary and re-installed following successful completion of the work in each area. Solvents detrimental to lacquer finishes are not to be used for cleaning these items.

3.4 APPLICATION

- .1 Apply paints and coatings by currently accepted trade methods.
- .2 Painting coats specified are intended to cover surfaces satisfactorily when applied in strict accordance with manufacturer's recommendations. Where proper coverage has not been attained, the Consultant may ask for additional coats as required, at no additional cost.
- .3 Apply each coat at the proper consistency. Sand lightly between coats.
- .4 Tint primers to same colour range as finish coats.
- .5 Do not apply finishes on surfaces that are not sufficiently dry. Each coat of finish should be dry and hard before a following coat is applied unless specified otherwise by the manufacturer.
- .6 Tint filler to match wood for clear finishes. Work filler well into wood grain and remove excess prior to setting.
- .7 Interior woodwork to receive paint or enamel finish shall be back-primed upon arrival on site with enamel undercoater.
- .8 All edges of wood doors shall be primed with undercoater, stain, or varnish, as required by specified finish.
- .9 Where spraying of paint is required by surface conditions, mask and seal off areas to be sprayed, and back-roll all coats. Provide ventilation for areas to be sprayed.
- .10 Where spray painting is specified, finish (100ft²) 10m² by spraying a sample of the finish upon the request of the Consultant, using materials specified.
- .11 Provide complete coverage and hide. When colour, stain, dirt or undercoats show through final coat of paint, provide additional coats until the paint film is of uniform finish, colour, appearance and coverage, at no additional cost to the Owner.

- .12 Allow all coats to dry to manufacturer's recommendations before applying succeeding coats.
 - .13 Touch up all suction spots or "hot spots" in concrete after the application of the first coat, before applying the second coat.
 - .14 Surfaces to be stained shall appear uniform in shading with colour variations caused only by the natural wood grain.
 - .15 Barricade areas where finishing is in progress to prevent traffic or other activities, and otherwise protect work until dry. Post "Wet Paint" signs and remove when no longer required.
 - .16 Replace at the expense of this section, materials soiled or damaged by finishing materials which cannot be removed.
- 3.5 CLEAN-UP
- .1 Upon completion of the work, remove all paint and varnish spots from floors, glass and other surfaces. Remove from the premises all rubbish and accumulated materials of whatever nature, not caused by others, and leave this work in clean, orderly and acceptable conditions.
- 3.6 PAINTING AND FINISHING SCHEDULE
- .1 The following titles and code numbers refer to Chapter 4 of the MPI Manual, unless otherwise indicated for type of coating, grade, named products and their manufacturers.
 - .1 Concrete Finishing Systems
 - .1 Concrete Vertical Surfaces; Premium Grade Finish.
 - .1 INT. 3.1A; Latex (over primer) Gloss/Sheen - G5.
 - .2 Concrete Horizontal Surfaces; Premium Grade Finish.
 - .1 INT. 3.2C; (EP) Epoxy, Gloss/Sheen - G5.
 - .2 INT. 3.2F; (FS) Concrete Floor Sealer, Gloss/Sheen – G3.
 - .3 Concrete Vertical/Horizontal Curb at Apparatus Bay; Vapour Barrier Paint.
 - .1 2-Part high-performance industrial epoxy coating; Seal-Krete Vapor-Shell, by Seal-Krete, Auburndale FL. refer to Section
 - .2 Masonry Finishing Systems
 - .1 Concrete Masonry Units; Premium Grade Finish.
 - .1 Painted Block (P)
 - .1 INT. 4.2A; Latex (over latex block filler), Gloss/Sheen - G3.
 - .2 Epoxy Painted Block (EP)

- .1 INT. 4.2G; Epoxy (tile-like, over epoxy block filler, for wet environments), Gloss/Sheen – G6.

- .3 Metal Finishing Systems
 - .1 Structural Steel; Premium Grade Finish.
 - .1 INT. 5.1C; W.B. Dry Fall (over Q.D. shop primer), Gloss/Sheen – G2.

 - .2 Metal Fabrications; Premium Grade Finish.
 - .1 INT. 5.1E; Alkyd (over Q.D. metal primer), Gloss/Sheen – G5.
 - .2 INT. 5.1K (EP); Epoxy-Modified Latex (over rust-inhibitive primer), Gloss/Sheen – G4.

 - .3 Galvanized Metals (not chromate passivated) – High Contact (Doors frames, railings balustrades, etc.) Premium Grade Finish.
 - .1 INT. 5.3C; Alkyd (over cementitious primer), Gloss/Sheen – G5.
 - .2 INT. 5.3D (EP); Epoxy (over epoxy primer), Gloss/Sheen – G4.

 - .4 Galvanized Metals (not chromate passivated) – Low Contact (overhead decking, pipes, conduit, ductwork etc.) Budget Grade Finish.
 - .1 INT. 5.3H; W.B. Dry Fall (Low Contact), Gloss/Sheen – G2.

- .4 Wood Finishing Systems
 - .1 Painted Wood (miscellaneous wood items); Premium Grade (3-coat) Finish.
 - .1 INT. 6.4A; Latex finish, satin.

 - .2 Clear Finish Wood (miscellaneous wood trim); Premium Grade (3-coat) Finish.
 - .1 INT. 6.4J; Clear Polyurethane (single component) finish, satin.

 - .3 Clear Finish Wood (Wood CLT Panels – Apparatus Bay).
 - .1 Beauti-Tone Clear Coat 100 Epoxy, by Tech Stone Floor & Wall Coatings Inc.

 - .4 Clear Epoxy Coating for Dining Table: 2-component clear epoxy; West Systems 105/207 or equivalent.

- .5 Plaster & Gypsum Board Finishing Systems
 - .1 Gypsum Board; Premium Grade Finish.
 - .1 INT. 9.2A; Latex (over latex primer sealer), Gloss/Sheen – G3.
 - .2 INT. 9.2F (EP); Epoxy-Modified Latex (over latex primer sealer), Gloss/Sheen – G3.
 - .3 Graphenstone Premium Range Paint – Graphclean.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide high performance coating for exterior steel.

1.3 REFERENCE STANDARDS

- .1 ASTM D2697; Test Method for Volume Non-volatile Matter in Clear or Pigmented Coatings.

1.4 SUBMITTALS

- .1 Make submittals in accordance with Section 01 30 00.
- .2 Product Data
 - .1 Submit product data for all Products specified herein.
 - .2 Submit WHMIS MSDS-Material Safety Data Sheets. Indicate VOC content.
- .2 Samples
 - .1 Submit duplicate (8" x 8") 200 x 200mm samples of each colour and finish applied to galvanized sheet steel.

1.2 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication

of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.5 DELIVERY, HANDLING AND STORAGE
 - .1 Deliver products to the site in original, unopened containers with manufacturer's labels intact. Labels shall indicate product designation, lot numbers and colour.
 - .2 Store products in cool, dry, well-ventilated area at (50 to 81°F) 10 to 27°C, and away from any open flame, spark or other heat source.
- 1.6 ENVIRONMENTAL REQUIREMENTS
 - .1 Ambient air and surface temperature shall be (40 to 120°F) 4 to 50°C at installation area for 24 hours prior to and 24 hours after application.
 - .2 Substrate temperature must be minimum (5°F) 3°C above dew point to prevent condensation.
 - .3 Applicators shall wear appropriate safety apparatus such as masks, gloves and protective eyewear and clothing.
 - .4 Provide adequate ventilation during mixing, application and curing.
- 1.7 SEQUENCING AND SCHEDULING
 - .1 Site application of polyurethane coating shall not commence until final welding is completed.
 - .2 For applications where site welding is not required, items to receive coating shall be shop-applied, spray finish.

- .3 For applications where site welding is required, items to receive coating shall be site-applied, brush finish.

1.8 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into Operations and Maintenance Manual.

2 PRODUCTS

2.1 MATERIALS

- .1 Primer (Prime Painted Steel): reinforced inorganic zinc primer; Catha-Coat 302H by DeVoe Coatings (ICI Canada Inc.).
- .2 Epoxy Intermediate Coating (Primer for Galvanized Steel): Two-component, chemically-cured zinc-rich epoxy coating;
 - .1 Acceptable Products
 - .1 Amercoat™ 240, by Amercoat Canada Inc.
 - .2 Devran™ 223, by DeVoe Coatings (ICI Canada Inc.) .
 - .3 Carbozinc® 895 VOC, by Carboline Company.
 - .3 Polyurethane Top Coating: Two component, fast drying, aliphatic acrylic polyurethane. Colours shall be custom colours as selected by the Consultant.
 - .1 Acceptable Products
 - .1 Amershield™ VOC, by Amercoat Canada Inc.
 - .2 Devthane™ 379H, by DeVoe Coatings (ICI Canada Inc.) .
 - .3 Carbothane® 134 VOC, by Carboline Company.

2.2 MIXING

- .1 Stir resin thoroughly and add cure to produce uniform mixture. Mixing ratio is 4 parts resin to 1 part cure by volume.

3 EXECUTION

3.1 PROTECTION

- .1 Mask all adjacent surfaces against overspray and provide wind barriers when application is exterior.

3.2 SURFACE PREPARATION

- .1 [Aluminum] [Galvanized steel]: Remove oil, grease or soap film with neutral detergent or emulsion cleaner. Pre-treat as recommended by coatings manufacturer. Abrasive blast all surfaces to SSPC–SP-7.
- .2 Prime Painted Steel: Remove all mill scale and rust. Abrasive blast where required to SSPC–SP-7. Touch up all affected areas with reinforced inorganic zinc primer.
- .3 Coated Surface: Abrasive-blast surface or clean using solvent emulsion.

3.3 GALVANIZED STEEL

- .1 Primer Coat: Apply one (1) coat epoxy coating to all galvanized steel surfaces by brush or spray application in accordance with manufacturer's instructions. Use zinc-rich epoxy primer as specified under Intermediate Coating above.
- 3.4 PRIME-PAINTED STRUCTURAL STEEL
 - .1 Primer Coat: Apply one (1) coat reinforced inorganic zinc primer to all prime painted steel surfaces by brush or spray application in accordance with manufacturer's instructions. Use reinforced inorganic zinc primer as specified under Primer above.
 - .2 Intermediate Coat: Apply one (1) coat intermediate epoxy coating to all prime-painted steel surfaces by brush or spray application in accordance with manufacturer's instructions.
- 3.5 TOP COAT APPLICATION
 - .1 General
 - .1 Apply topcoat to all exterior steel, in minimum two (2) coats, in 2 directions to ensure full even application.
 - .2 Apply coating to produce smooth surface, uniform in sheen, colour and texture, free from marks, dirt, particles, runs, crawls, curling, holes, air pockets and other defects.
 - .3 Application of (8 mil) 200 micron wet film thickness, shall produce minimum (5 mil) 125 micron dry film thickness.
 - .2 Brush-application
 - .1 Where brush-applied, remove brush lines and drips in coating.
 - .3 Spray-application
 - .1 Apply coating using airless or electrostatic spray equipment.
 - .2 Apply a wet coat in even, parallel passes, overlapping each pass 50%. If required, cross spray at right angles.
- 3.6 CLEANING
 - .1 Clean surfaces to coating manufacturer's printed instructions.
- 3.7 SCHEDULE
 - .1 Apply coating system to all exterior galvanized and prime painted structural and miscellaneous steel. Items to receive coatings include, but are not limited to the following:

PRIME PAINTED STEEL	GALVANIZED STEEL
Columns	--

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, Products, materials, equipment and incidental services necessary to provide wall mounted tackboards.

1.3 REFERENCE STANDARDS

- .1 ASTM A653/653M; Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM B221; Specification for Aluminum-Alloy Extruded Bars, Rods Wire, Profiles and Tubes.
- .3 ASTM D1037; Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
- .4 ASTM E84; Test Method for Surface Burning Characteristics of Building Materials and Assemblies.
- .5 Aluminum Association Designation System for Aluminum Finishes.

1.4 SUBMITTALS

- .1 Make submittals in accordance with Section 01 30 00.
- .2 Shop Drawings
 - .1 Submit shop drawings indicating location, type, size, panel arrangement, backing, hardware, anchor or mounting details, frame or trim and accessories.
- .3 Samples

- .1 Submit samples of panel trim in specified finish for verification.
- .4 Maintenance Data
 - .1 Provide maintenance data for tackboards for incorporation into Operations and Maintenance manual.
 - .2 Affix removable maintenance instruction labels to all tackboards.
- 1.5 SITE CONDITIONS
 - .1 Site verify all dimensions and identify any and all potential interference from adjacent millwork or fixtures, prior to fabrication and installation. Where potential interference exists, report such instances in writing to the Consultant prior to fabrication.

2 PRODUCTS

2.1 TACKBOARD SYSTEMS (TB)

- .1 Tackboard System: a.s.p. "Elite Reveal System", as manufactured by Architectural School Products Ltd., Mississauga, ON (905) 822-4287.

2.2 PANEL MATERIALS

- .1 Krommenie cork tackboard site applied consisting of 6mm (1/4") thick Forbo Krommenie Bulletin board laminated to 17mm (5/8") fir plywood and 3mm (1/8") tempered hardboard spacers.
- .2 Colour of Krommenie cork to be selected from manufacturers standard solid colour range.
- .3 Laminating adhesive: manufacturer's standard.

2.3 TRIM AND FRAMING

- .1 Extruded Aluminum: Aluminum Association alloy 6063-T5.
- .2 Elite Series Architectural: extruded aluminum trim, of manufacturer's standard sections appropriate for installation conditions.
- .3 Aluminum angle to be 6063T5 alloy, clear etched and anodized 0.051mm (.002") satin finish, free from extruding draw marks and surface scratches, 25.4mm x 25.4mm x 3mm (1" x 1" x 1/8") and mitred corners.
- .4 Finish: Clear Anodized, Class II to AA-M12C22A3, #17.

2.4 FABRICATION

- .1 Fabricate tackboards to configurations shown on the drawings.

3 EXECUTION

3.1 INSTALLATION

- .1 Install tackboards in accordance with manufacturer's instructions, to provide rigid, secure installation.

3.2 CLEANING

- .1 Clean surfaces after installation using manufacturer's recommended cleaning procedures.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide exterior building signage.

1.3 SAMPLES

- .1 Provide one sign letter representative of type specified in appropriate size and colour, in accordance with Section 01 30 00.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 30 00.
- .2 Clearly indicate material and large scale details showing anchor types, letter types, finishes and methods of installation.

2 PRODUCTS

2.1 MATERIALS

- .1 Aluminum Letters: 50mm letter depth, on stand-offs, secured to aluminum panel, as manufactured by Gemini Canada, or an approved alternative. Refer to the drawings for details.
 - .1 Finish: brushed aluminum.
- .2 Fasteners and hardware: Stainless steel.

2.2 LETTERING STYLE AND SIZE

- .1 Lettering style as selected by the Consultant. Letter size as indicated on the drawings.

3 EXECUTION

3.1 INSTALLATION

- .1 Letters to be installed square and level as indicated on shop drawings. Anchor letters securely to masonry wall. Clean all letters after installation.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide post-mounted regulatory traffic signs.

1.3 REFERENCE STANDARDS

- .1 CSA-A23.1; Concrete Materials and Methods of Concrete Construction.
- .2 CAN/CSA-G40.20/G40.21; General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steels.
- .3 CAN/CSA-G164; Hot Dip Galvanizing of Irregular Shaped Articles.

1.4 SUBMITTALS

- .1 Shop Drawings/Product Data
 - .1 Provide full scale sign layouts for all signs specified, for review by the Consultant. Layouts shall include correct symbols, lettering, lettering styles, and shall indicate colours.

2 PRODUCTS

2.1 MATERIALS

- .1 Sign Posts
 - .1 One piece, cold-rolled channel sign posts, 64mm wide x 32mm deep, hot-dip galvanized steel, 4.2mm base metal thickness, minimum 340MPa yield, perforated for sign attachment, as manufactured by Armtex Limited, or an approved alternative. Provide mounting hardware.

- .2 Signs
 - .1 Hot-dip galvanized sheet steel, with MTO standard traffic colours and graphics.

- .3 Concrete
 - .1 Proportion normal density concrete in accordance with CSA-A23.1, and as follows:
 - .2 Cement: Type 10 Portland Cement.
 - .3 Minimum compressive strength at 28 days: 25Mpa.
 - .4 Exposure Classification: C-2.
 - .5 Coarse Aggregate Size: 16mm, crushed (smooth aggregate not acceptable).
 - .6 Slump at time and point of discharge: 80mm ± 20mm.

3 EXECUTION

3.1 INSTALLATION

- .1 Place concrete in post holes then embed posts into concrete to minimum 780mm depth. Extend concrete maximum 25mm above ground level and slope to drain away from posts.

- .2 Brace posts in plumb position and true to alignment and elevation until concrete has set.

- .3 Bolt signs to top of posts with tamper-proof galvanized steel bolts and nuts.

3.2 SCHEDULE

- .1 Refer to sign details on the drawings. Refer to Site Plan A1.1 for locations of the following signage:
 - .2 Stop (ST)
 - .1 Provide signs post-mounted at locations indicated on the drawings.

 - .3 No Parking / Fire Route (FR)
 - .1 Provide post-mounted signs along driveways as required by local fire and municipal authorities, in conformance with local by-laws and regulations.

 - .4 Barrier Free Parking (BF)
 - .1 Provide signs post-mounted at each new BF parking stall.

 - .5 Drop-Off Zone / 5 Min. Parking (DO)
 - .1 Provide post-mounted signs where indicated, in conformance with local by-laws and regulations.

 - .6 Loading Zone / No Parking (LZ)

- .1 Provide post-mounted signs where indicated, in conformance with local by-laws and regulations.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide all prefabricated interior aluminum partition and screen systems.

1.3 REFERENCE STANDARDS

- .1 Aluminum Association (AA); DAF-45, Designation System for Aluminum Finishes.
- .2 ASTM B209; Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 ASTM B221M; Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
- .4 CAN/CSA G164; Hot Dip Galvanizing of Irregularly Shaped Articles.
- .5 CAN3-S157; Strength Design in Aluminum.
- .6 CSA W59.2; Welded Aluminum Construction.

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
- .2 Installation/Application

- .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.5 PERFORMANCE REQUIREMENTS
 - .1 Structural performance shall be based on CAN3-S157, Strength Design in Aluminum, and a maximum deflection of 1/175 of the span.
 - .2 Size glass units and glass dimensions to limits established in CAN/CGSB-12.20.
- 1.6 SUBMITTALS
 - .1 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 30 00.
 - .2 Indicate materials and large scale details for profiles of components, elevations of unit, anchorage details, required reinforcing, description of related components, finishes and fasteners.
 - .2 Product Data
 - .1 Submit product data for the following, in accordance with Section 01 30 00:
 - .1 Material composition
 - .2 Finishes
 - .3 Hardware requirements

2 PRODUCTS

2.1 MANUFACTURERS

- .1 PC350 Architectural Walls, Markham ON.
- .2 Solare Modular Partitions Ltd., Toronto ON.

2.2 PARTITION SYSTEM

-
- .1 Glazed Partition System (all glass doors, glazed screens, glazed transoms, and glazed office/meeting room fronts):
 - .1 Elite Wall Double Glazed by PC350 Architectural Walls
 - .2 Glazed Partition System shall include:
 - .1 (4") 102mm wide black anodized aluminium frame system
 - .2 Double-glazed transoms, screens, sidelights, and office/meeting room fronts.
 - .3 (7.25") 184mm high standard floor skin (base)
 - .4 Wall Caps (Drywall Partition Cap/Cover Detail)
 - .5 Minimum 35 STC rating
 - .6 Sliding frameless glass doors; one pane of (3/8") 10mm min. thick tempered glass; with all required hardware including hinges, locks/latches, sliding track system, stops.
 - .3 For locations, sizes, and configurations see both the Drawings, and the Door & Screen Schedule.
 - .2 Door Frame System:
 - .1 SRT in-line sliding doors and frames, by PC350 Architectural Walls.
- 2.3 MATERIALS
- .1 Aluminum Members: Alcan 6063-T54 alloy and temper.
 - .2 Extruded Aluminum: to ASTM B221.
 - .3 Sheet Aluminum: ASTM B209.
 - .4 Screws, bolts and fasteners: 300 series stainless steel or 400 series stainless steel cadmium plated.
 - .5 Steel Reinforcement: to CAN/CSA-G40.21, grade 300W, as required by system design limitations.
 - .6 Vision Glass: refer to Section 08 80 00.
 - .7 Glazing gaskets: extruded, black, closed cell or dense elastomer of durometer appropriate to the function.
 - .8 Sealants: refer to Section 07 92 00.
 - .9 Isolation Coating: alkali resistant, epoxy resin solution.
- 2.4 FINISH
- .1 Anodized: Class I , Black.
- 2.5 FABRICATION
- .1 Fabricate frames from extrusions of size and configurations shown on drawings.
 - .2 Corner construction shall be mechanical clip, and screw fastening.

- .3 Fabricate units square and true with maximum tolerance of plus or minus (1/16")1.5mm for units with a diagonal measurement of (6'-0")1800mm or less and plus or minus (1/8")3mm for units with a diagonal measurement over (6'-0")1800mm.
- .4 Face dimensions detailed are maximum permissible sizes.
- .5 Brace frames to maintain squareness and rigidity during shipment and installation.
- .6 Provide all internal reinforcing as required for the proper structural design and support of the framing system.

3 EXECUTION

3.1 INSTALLATION

- .1 Erect and anchor all frames square and level using concealed fastenings where possible.
- .2 Anchors to be built into the structure shall be provided to the General Contractor for setting in accordance with the approved shop drawings.
- .3 Partitions shall be installed and glazed by experienced personnel in accordance with the manufacturer's instructions and reviewed shop drawings.
- .4 All items in this Section shall be set in their correct location and shall be set level, square, plumb and at proper elevations and in alignment with other work.
- .5 Manufacturer's nameplates or labels shall not be installed on screens.

3.2 CLEANING

- .1 During installation, remove all corrosive or foreign materials or droppings resulting from work of this or other trades.
- .2 Clean all surfaces in accordance with manufacturer's instructions for final cleaning of finished surfaces.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
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- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide pre-manufactured wall and door protection;
 - .1 Corner guards

1.3 SUBMITTALS

- .1 Make submittals in accordance with Section 01 30 00.
- .2 Product data
 - .1 Submit complete Product data for each Product specified.
- .3 Samples
 - .1 Submit duplicate (8") 200mm long samples of door and wall protection Products in profiles and colours specified for review by Consultant. Where Products have mounting plates, submit sample of mounting plates also.
 - .2 Submit complete colour swatches for colour selections by the Consultant.
- .4 Shop Drawings
 - .1 Shop drawings shall indicate by large-scale details, all materials, finishes, dimensions, anchorage and assembly.

1.4 DELIVERY STORAGE AND HANDLING

- .1 Deliver Products to the site in their original unopened packaging.

- .2 If not installed immediately, store Products in a secure area, away from construction operations.

1.5 WARRANTY

- .1 Provide manufacturer's warranty against material and manufacturing defects for a period of five (5) years from Date of Substantial Performance.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 CS / Construction Specialties Ltd., Mississauga, ON.
- .2 IPC (Institutional Products Corporation), Muskego WI.
- .3 Korogard Wall Protection Systems, Fairlawn OH.

2.2 MANUFACTURED UNITS

- .1 Corner Guards (CG): Surface-mounted, 16 gauge, Type 316 stainless steel (#4 finish) 90 deg. corner guard, (1") 25mm legs, sharp nose edge configuration, adhesive tape mounted:
 - .1 Quantity: 20 (where indicated, and as directed by the Consultant).
 - .2 Height: (48") 1220mm (typical, or custom length as required at millwork applications).
 - .3 Acceptable Products;
 - .1 CS Construction Specialties Ltd. "Model CO-8".
 - .2 IPC (Institutional Products Corporation) "Model 180 CMT".
 - .3 Korogard Stainless Steel Corner Guards.

2.3 ACCESSORIES

- .1 Fasteners: self-tapping stainless steel, concealed mounting.
- .2 Adhesive: water resistive type as recommended by manufacturer for the applicable substrate.

3 EXECUTION

3.1 INSTALLATION

- .1 Corner Guards
 - .1 Install units on solid backing and erect with materials and components straight, tight and in alignment.
 - .2 Where fastening to stud partitions, screws must be fastened to studs.
 - .3 Mechanically fasten units, straight and level to variation plus or minus 3mm over 3m, non-cumulative.

3.2 CLEANING

- .1 Clean all Products in accordance with manufacturer's instructions.
- .2 Remove excess adhesive and all layout marks.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

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- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, Products, equipment and incidental services necessary to Provide all washroom accessories specified herein.
- .2 The following Washroom accessories not specified herein, will be supplied by the Owner for installation by the Contractor:
 - .1 Toilet paper Dispensers.
 - .2 Soap Dispensers.
 - .3 Paper Towel Dispensers.

1.3 REFERENCE STANDARDS

- .1 ASTM A167; Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- .2 ASTM A525M; Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process.
- .3 ASTM A526M; Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process, Commercial Quality.
- .4 ASTM B456; Specification for Electro-deposited Coating of Copper + Nickel + Chromium and Nickel + Chromium.
- .5 ASTM C1503; Specification for Silvered Flat Glass Mirror.
- .6 CAN/CGSB-12.5; Mirrors, Silvered.
- .7 CAN/CSA-B651; Barrier-Free Design.
- .8 CAN/CSA-G164; Hot Dip Galvanizing of Irregularly Shaped Articles.

1.4 SHOP DRAWINGS

- .1 Make submittals in accordance with Section 01 30 00.

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- .2 Product Data
 - .1 Submit manufacturer's Product data for all items specified herein.
 - .2 Indicate size and description of components, base material, surface finish inside and out, hardware and locks.
 - .3 Shop Drawings
 - .1 Submit shop drawings of all items specified herein.
 - .2 Indicate attachment devices, description of rough-in frame, and building-in details of anchors for grab bars.
 - 1.5 MAINTENANCE MATERIALS AND DATA
 - .1 Provide operation and maintenance data for washroom accessories for incorporation into Maintenance Manual in accordance with Section 01 78 00.
 - .2 Provide two (2) complete sets of special tools required for accessing, assembly/disassembly or removal of washroom accessories.
 - 1.6 EXTENDED WARRANTIES
 - .1 Submit warranty certificates from Product manufacturer(s) as follows:
 - .1 Silver coating on mirrors – 15 years.
 - 2 PRODUCTS**
 - 2.1 MATERIALS
 - .1 Sheet Steel: commercial quality, to ASTM A526 with ZF001 zinc coating.
 - .2 Stainless Steel Sheet Metal: to ASTM A167, Type 304, minimum (22 gauge) 0.80mm thick.
 - .3 Stainless Steel Tubing: Type 304, commercial grade, seamless welded, (18 gauge) 1.27mm wall thickness.
 - .4 Glass for Mirrors: to CAN/CGSB-12.5 and ASTM C1503; (1/4") 6mm, tempered glass.
 - .5 Fasteners: concealed screws and bolts shall be hot-dip galvanized or stainless steel; all exposed fasteners stainless steel to match face of unit. Use plastic or lead expansion shields as recommended by fixture manufacturer for component, and its intended use.
 - 2.2 FINISHES
 - .1 Chrome and Nickel Plating: to ASTM B456, polished finish.
 - .2 Stainless Steel: AISI No. 4 finish, (satin).
 - 2.3 COMPONENTS
 - .1 Framed Mirrors **(MR)**: stainless steel channel frame, vandal-proof concealed fastenings, one unit per lavatory, One-piece, (1/2" x 1/2" x 3/8") 13 x 13 x 10mm channel-frame. Type 304 stainless steel with satin finish and mitered corners. (1/4") 6mm tempered mirror glass to ASTM C1503.

Galvanized steel back. Secured to concealed wall hanger with theft-resistant (18 gauge) 1.214mm steel mounting brackets;

- .1 **MR.1:** (24" x 36") 610mm x 914mm, fixed angled frame for barrier-free application.
 - .1 Acceptable Products:
 - .1 B-293x2436, by Bobrick.
 - .2 Model 740-02436-2 by Bradley.
 - .3 Model 941FT-2436 by Frost
 - .4 Model 0535-B by ASI.

- .2 Grab Bars (**GB**): (1¼") 32mm diameter, Type 304, (18 gauge) 1.27mm satin finish stainless steel tubing grab bars, with peened grip. Concealed mounting flange (1/8") 3mm thick, Type 304 stainless steel plate, (2") 50mm W x (3 1/8") 80mm H, with screw holes for concealed anchors. Cover of (3¼") 85mm diameter (12 gauge) 2.78mm stainless steel wall flanges. Grab bars to withstand downward force of 2.2N;
 - .1 **GB.1:** (30" x 30") 762 x 762mm L-shaped; mounted beside WC and ACS;
 - .1 Acceptable Products:
 - .1 B-716722.99-L30x30 by Bobrick.
 - .2 837-057 Series by Bradley.
 - .3 Model 1003-30x30 by Frost.
 - .4 Model 3104-M3030P by ASI.

 - .2 **GB.2:** (24") 610mm long, mounted horizontally behind WC;
 - .1 Acceptable Products:
 - .1 B-5806.99x24 by Bobrick.
 - .2 812 Series by Bradley.
 - .3 Model 1001-24 by Frost.
 - .4 Model 3101-24P by ASI.

 - .3 **GB.3:** (30" x 39") 750mm x 1000mm L-shaped, mounted in showers;
 - .1 Acceptable Products:
 - .1 B-68137.99 by Bobrick.
 - .2 837-057 Series by Bradley.
 - .3 Model 1016 by Frost.
 - .4 Type 56P by ASI.

 - .4 **GB.4:** (39") 1000mm long, mounted vertically in Showers;
 - .1 Acceptable Products:
 - .1 B-5806.99x24 by Bobrick.
 - .2 812 Series by Bradley.
 - .3 Model 1001-24 by Frost.
 - .4 Model 3101-24P by ASI.

- .3 Coat Hooks (**CH**): Satin finish stainless steel.
 - .1 **CH.1:** single hook;
 - .1 Acceptable Products:
 - .1 B-6827 by Bobrick.

-
- .4 Mop Hooks (**MH**): Type 304 stainless steel, satin finish. Anti-slip mop holders have spring-loaded rubber cam that grips handles (7/8" to 1-1/4") 20–30mm diameter. Holds 1 mop (3-1/4") 85mm from wall.
- .1 Acceptable Products:
 - .1 B-223 by Bobrick.
- .5 Mop Racks/Shelves (**MR**): (24") 610mm long. Type 304 stainless steel, satin finish. Anti-slip mop holders have spring-loaded rubber cam that grips handles (7/8" to 1-1/4") 20–30mm diameter. Holds 3 mops (3-1/4") 85mm from wall. Height (5") 125mm.
- .1 Acceptable Products:
 - .1 B-224x36 by Bobrick.
 - .2 Model 9984 by Bradley.
 - .3 Model 1115 by Frost.
 - .4 Model 1315-4 by ASI.
- .6 Universal Washroom Shelf (**UWS**): (18") 460mm long x (4") 100mm wide, surface mounted Type 304 stainless steel, AISI No. 4 brushed finish with (3/4") 19mm return edge;
- .1 Acceptable Products:
 - .1 MS-18, by Gamco Commercial Restroom Accessories (Div. of Bobrick).
 - .2 Model 950-4-18 by Frost.
 - .3 Model 754-18 by Bradley.
 - .4 Model 0692-418 by ASI.
- .7 Sanitary Napkin Disposal (**SND**): surface mounted satin-finish stainless steel. Door has tumbler lock. Self-closing panel covers disposal opening. Removable, leak-proof, 1.2-gal. (4.6-L) plastic receptacle.
- .1 Acceptable Products:
 - .1 B-35303 by Bobrick.
- .8 Folding Shower Seat (**FSS**): wall-mounted, folding seat; colour as selected by Consultant;
- .1 Acceptable Products:
 - .1 B-5181 by Bobrick.
 - .2 Model 9569 by Bradley.
 - .3 Model 975 by Frost.
 - .4 Model 8206-28 by ASI.
- .9 Shower Rod & Curtain (**SRC**): (1") 25mm diameter, Type 304 stainless steel shower rod, vinyl shower curtain, and steel hooks.
- .1 Acceptable Products:
 - .1 B-6107 rod, B204-2 vinyl shower curtains, B204-1 hooks, by Bobrick.
 - .2 Model 9538 rod, 9533 vinyl shower curtains, 9536 hooks, by Bradley.
 - .3 Model 1145-S rod, 1144-502 vinyl shower curtains, 1144-501L hooks, by Frost.
 - .4 Model 1214 rod, 1200-V vinyl shower curtains, 1200-SHU hooks, by ASI.

2.4 FABRICATION

- .1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.
- .2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.
- .3 Brake form sheet metal work with 1.5mm radius bends.
- .4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- .5 Back-paint components where contact is made with building finishes to prevent electrolysis.
- .6 Hot-dip galvanize concealed ferrous metal anchors and fastening devices to CSA G164.
- .7 Shop-assemble components and package complete with anchors and fittings.
- .8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.
- .9 Provide steel anchor plates and components for installation on studding and building framing.

3 EXECUTION

3.1 INSTALLATION

- .1 Install and secure fixtures rigidly in place as follows:
 - .1 Stud walls: install steel back-plate or 2x10 solid wood blocking to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.
 - .2 Hollow masonry units: use toggle bolts drilled into cell/wall cavity.
 - .3 Solid masonry: use bolt with lead expansion sleeve set into drilled hole.
 - .4 Toilet/shower compartments: use male/female through bolts.
- .2 Install grab bars on built-in anchors provided by bar manufacturer. Supply templates, details and instructions for building in anchors in toilet compartments. Provide through bolt fastening of grab bars in toilet compartments.
- .3 Use tamperproof screws/bolts for fasteners.
- .4 Install framed mirrors using concealed fasteners in locations indicated.
- .5 Locate accessories where indicated on the drawings and/or as directed by the Consultant.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide all prefabricated metal lockers.
 - .1 Dorm Room lockers.

1.3 REFERENCE STANDARDS

- .1 ASTM A653; Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 CSA-W59; Welded Steel Construction (Metal Arc Welding).

1.4 SUBMITTALS

- .1 Make submittals in accordance with Section 01 30 00.
- .2 Shop Drawings
 - .1 Submit shop drawings for all lockers.
 - .2 Indicate gauges of metal, fabricating methods, assembled banks of lockers, bases, trim, numbering, filler panels & end panels.
 - .2 Include all installation instructions, and requirements for wall strapping.
- .2 Samples
 - .1 Submit duplicate complete colour selection charts to the Consultant to assist in colour selections.
 - .2 Submit duplicate sheet steel colour sample chips in colours selected by the Consultant for verification purposes.

- 1.5 MOCK-UP
 - .1 Construct mock-ups in accordance with Section 01 30 00.
 - .2 Construct mock-up of one bank of 5 single lockers in place, complete with all components.
 - .3 Allow for review by Consultant prior to proceeding with the work. Work accepted by the Consultant may form part of the finished installation.
- 1.6 DELIVERY, STORAGE AND HANDLING
 - .1 Deliver materials in original unopened packages, clearly labeled with manufacturer's name and product designation.
 - .2 Store products in safe dry area, protected from elements, and construction traffic.
 - .3 Handle in such a manner to ensure against racking, distortion, or physical damage of any kind.

2 PRODUCTS

2.1 MATERIALS

- .1 Sheet steel: commercial grade, stretcher-leveled sheet steel to ASTM A653. Thicknesses specified are "base metal thickness" prior to galvanizing or finishing.

2.2 REST AREA LOCKERS

- .1 Standard Lockers
 - .1 Emperor Series, by Hadrian Manufacturing Inc., Burlington Ontario.
 - .2 Elite Series, by General Storage Systems (GSS), London Ontario.
 - .3 Deluxe Series, by Shanahan's Manufacturing Limited, Calgary AB.
- .2 Locker Sizes:
 - .1 Single Tier Standard Lockers
 - .1 Width: (18") 460mm.
 - .2 Depth: (18") 460mm.
 - .3 Height: (72") 1828mm.
- .3 Options Included
 - .1 End / Side panels
 - .2 Metal box bases
 - .3 Sloped Tops
- .4 Latch set: single point through recessed metal pocket.
- .5 Locking System
 - .1 Padlocks: as supplied by the Owner.

2.2 FABRICATION

- .1 All Lockers
 - .1 Fabricate lockers to the following base metal thickness:

- .1 Locker bodies (top, shelf, bottom, sides, back, dividers): (24 gauge) 0.7mm.
 - .2 Box Bases, Sloped Tops and Trim: (24 gauge) 0.7mm.
 - .3 Doors (outer face): (20 gauge) 1.0mm.
 - .4 Doors (inner panel): (24 gauge) 0.7mm.
 - .5 Door Frames: (16 gauge) 1.6mm.
 - .6 Hinges: (18 gauge) 1.2mm.
- .2 Fabricate doors in double pan construction, from (20 gauge) 1.0mm outer panel, welded to (24 gauge) 0.7mm inner panel, with (1") 25mm cell structural honeycomb core. Provide rubber door bumpers (minimum 2 per door) for all doors.
 - .3 Fabricate frames of (16 gauge) 1.6mm formed steel channels, welded to form a rigid box structure with integral door stop, welded steel hasp, and full lintel support under bottom shelf.
 - .4 Provide unobstructed ventilation by means of louver perforations in locker frames, coupled with perforations in shelves.
 - .5 Fabricate locker bodies (sides, backs, tops, bottoms, shelves, dividers) from pre-painted (24 gauge) 0.7mm steel with edges formed to provide rigid assembly when bolted or pop-riveted together. Tops, bottoms and shelves shall be flanged on all sides with hemmed channel front edges for shelves.
 - .6 Latching/Locking Device: (11 gauge) 3.038mm, (2") 51mm x (3/4") 19mm padlock hasp shall be securely welded to the continuous strike midway up on the frame and centered at the handle location. Hasp shall be formed to protrude through an extruded aluminum recessed handle, clip-locked and bonded to the door. Handle's inner surface shall be concave and grooved for fingertip door control. To keep the door closed when not in use, a (1/2") 13mm O.D. nylon friction catch shall be installed on the door to engage the frame in one (1) location.
 - .7 Hinge: A full-length (18 gauge) 1.214mm continuous piano hinge shall be securely welded to the frame and fastened to the door with screws or rivets.
 - .8 Ventilation: Airflow is achieved through 4 sets of 5 unobstructed louvers (3/4") 19mm wide x (1/4") 6mm high in the vertical frame members. Provide 18 each (3/16") 5mm diameter perforations at outside perimeter of each top, shelf, and bottom to offer additional ventilation throughout the inside of each locker.
 - .9 Fabricate box bases, sloped tops, fillers, and trims from pre-painted (24 gauge) 0.7mm steel with edges formed to provide rigid assembly when bolted or pop-riveted together.

- .10 Interior Equipment:
 - .1 Single Tier: double-prong coat hooks and (1") 25mm O.D. coat rods with stainless steel brackets. All hooks are chrome-plated steel with ballpoint heads and attached with two fasteners.
- .11 Number Plates: each door shall have a high-strength, black, laminated plastic, number plate, (2-1/2") 64mm wide x (1-1/8") 29mm high with numbers not less than (7/16") 11mm high. Plates shall accommodate up to four digits, be set in a recess flush with door surface and shall be fastened to door with two rivets. Lockers will be numbered consecutively from 1 – up as directed by the Owner.
- .12 Fasteners: cadmium-plated steel tamperproof type screws and bolts.

2.3 FINISH

- .1 All painted steel surfaces shall be factory-finished with electro-statically applied, thermosetting, powder coat polymer enamel. Site painting is not acceptable.
- .2 Colours
 - .1 Frames, fillers, and trim: colour to match doors.
 - .2 Interior: standard grey colour.
 - .3 Exterior: 607 Bordeaux. End panels to match doors.

3 EXECUTION

3.1 EXAMINATION

- .1 Examine all adjacent surfaces and confirm their acceptance as substrates prior to locker installation.
- .2 Confirm location and extent of wall strapping conforms to manufacturer's requirements for installation.
- .3 Commencement of locker installation shall imply acceptance of substrate conditions.

3.2 INSTALLATION

- .1 Assemble and install lockers in accordance with manufacturer's installation instructions.
- .2 Provide separation membrane (dampproof course) between steel lockers and all concrete surfaces.
- .3 Securely fasten lockers to wood nailing strips. Ensure installation is plumb, square and level.
- .4 Install wall trim around recessed locker banks.

- .5 Install filler panels (false fronts) where indicated and where obstructions occur.
- .6 Install finished end panels to all exposed ends of locker banks.
- .7 Install sloped tops as indicated, complete with fillers, ends, and trims as required.
- .8 Install benches where indicated on the drawings. Bolt securely to floor slab.

3.3 CLEANING AND PROTECTION

- .1 Protect surfaces of lockers from damage, from time of installation until final cleaning immediately prior to final inspection.
- .2 Leave protective films in place where present until time of final cleaning.
- .3 Clean surfaces of lockers in accordance with manufacturer's instructions immediately prior to final inspection.
- .4 Replace dented, scratched, or otherwise defective components with new components prior to final inspection.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide complete prefabricate flagpoles.
 - .1 Building mounted flagpoles

1.3 DESIGN CRITERIA

- .1 Design flagpole, base and anchorage devices to resist minimum wind velocity of (90 mph) 145 km/h (flagged).

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 30 00.
- .2 Indicate dimensions, finishes, base jointing, anchorage and support systems, cleats, halyard boxes, trucks, finials and base collar for flagpoles.

1.5 DELIVERY AND STORAGE

- .1 Spiral wrap flagpole with heavy kraft paper, wood strip and steel band, or polyethylene wrap and pack in tubing for shipment.
- .2 Deliver flagpoles in one piece.
- .3 Store flagpoles on roof of building, or in area safe from potential damage.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 Rockwood Flagpole Co.
- .2 Ewing Flagpole Co. Inc., Agincourt ON.
- .3 Flag Outlet, London ON.
- .4 Flags Unlimited

2.2 MATERIALS

- .1 Aluminum: seamless spun aluminum, 6063-T6 alloy.

2.3 COMPONENTS

- .1 Poles: seamless aluminum, (12 ft) 3657mm high, for 3 flags.
 - .1 Basis for Design: Economy Style Pole by Flag Outlet, London ON.
 - .2 Finish: black anodized.
- .2 Mounting Brackets: stationary wall-mounted fixed heavy-duty anchor brackets (228mm x 432mm for 89mm diameter pole) in finish to match poles. Provide 13mm diameter mounting rods to CLT Subcontractor for factory installation in CLT panels. Rods to be of sufficient length to penetrate full wall assembly and project beyond mounting bracket. Nuts and washers to be fastened to threaded rods to ensure appropriate and secure fastening.
- .3 Flags: provide the following;
 - .1 1 Standard Nylon Flag 914mm x 1525mm; Canada.
 - .2 1 Standard Nylon Flag 914mm x 1525mm; Province of Ontario.
 - .3 1 Standard Nylon Flag 914mm x 1525mm; City of Peterborough.

3 EXECUTION

3.1 INSTALLATION

- .1 Install flagpoles, base assemblies and fittings to approved shop drawings and manufacturer's instructions.
- .2 Check and adjust installed fittings for smooth operation of halyards.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Work of this section includes the design, supply and installation of a fall restraint system;
 - .1 Fall Arrest Anchors.
 - .2 Lifeline System.

1.3 REFERENCES

- .1 CAN/CSA-Z91; Safety Code for Window Cleaning Operations.
- .2 CAN/CSA-Z271; Safety Code for Suspended Elevating Platforms.
- .3 Ontario Occupational Health and Safety Act Window Cleaning Regulation 859/90 as amended by 523/92, and 213/91 as amended by 631/94 (Construction Projects).
- .4 CSA S16.1; Steel Structures for Buildings.
- .5 CSA S136; Design of Steel Structural Members, Light Gauge.
- .6 CISC 2; Standard Practice for Steel, Structural, for Buildings.
- .7 CSA W59; Welded Steel Construction
- .8 CSA W47; Certification of Companies for Fusion Welding of Steel Structures.
- .9 CAN3-S157; Strength Design in Aluminum.
- .10 CAN3-S244; Welded Aluminum Design.
- .11 CSA-W47.2; Aluminum Welding Qualification Code.
- .12 CSA G164; Hot Dip Galvanizing, of Irregularly Shaped Articles.

1.4 DESIGN REQUIREMENTS

- .1 Design fall restraint system to suit building and in accordance with plans, specifications, standards, and regulations/codes specified herein.
- .2 Design all anchor components to provide adequate attachment to the building and suited to current window cleaning/suspended maintenance practices. Ensure compatibility with industry standard equipment.
- .3 Ensure all anchor components conform to proper engineering principles and have been designed by a Professional Engineer qualified in the design of window cleaning/suspended maintenance equipment, its application and safety requirements.
- .4 Design system fall arrest safety anchors and equipment supports to comply with the following structural requirements:
 - .1 Fall Arrest Safety Anchors: designed to resist a 22.2kN load in any direction without detachment or fracture occurring. To avoid deformation under normal usage, anchors are to be generally designed to resist a 4.5kN static working load in any direction.
 - .2 Ensure design of primary support equipment is capable of sustaining without failure at least four times the maximum static working load applied or transmitted to the components (i.e. a 4 to 1 stability factor).

1.5 SHOP DRAWINGS

- .1 Submit shop drawings showing complete layout and configuration of complete fall restraint system, including all components and accessories. Clearly indicate design and fabrication details, hardware, and installation details.
- .2 Shop drawings to include installation and rigging instructions and all necessary Restrictive and Non-Restrictive Working Usage Notes and General Safety Notes.
- .3 All shop drawings must be signed and sealed by a professional Engineer, licensed to practice in the Province of Ontario.
- .4 Submit copies of all test reports.

1.6 QUALITY ASSURANCE

- .1 Manufacturer: Work of this Section to be executed by manufacturer specializing in the design, fabrication and installation of fall arrest anchors and window cleaning/suspended maintenance systems, having a minimum of 5 years documented experience. If requested by the Consultant, submit written proof of experience.

- .2 Loading and safety assurance: Work of this Section to meet the requirements of governing codes and jurisdiction and to comply with properly engineered loading and safety criteria for the intended use.
 - .3 Insurance: Manufacturer to carry specific liability insurance (products and completed operations) in the amount of \$2,000,000.00 to protect against product/system failure.
 - .4 Welding to be executed by certified welders in accordance with CSA W59 and CSA W47.2 requirements.
 - .5 Pre-construction Meeting: Convene a pre-construction meeting for the work specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager),
 - .2 Installation Subcontractor (Site Foreman & Project Manager),
 - .3 Related Subcontractors (ie. Roofing, Steel), and
 - .4 Consultant.
- 1.7 MAINTENANCE DATA
- .1 Submit 1 copy of system Equipment Manual & Inspection Log Book, with “Initial Inspection - Certification for Use” and “Inspection Sign-Off” forms completed.
 - .2 Submit 2 copies of a reduced plastic laminated as-built shop drawing showing equipment locations and details. This drawing is to be posted near exits onto the roof.
- 2 PRODUCTS**
- 2.1 MANUFACTURERS
- .1 Acceptable Manufacturers
 - .1 Pro-Bel Enterprises Ltd.
 - .2 Telco Industries Inc.
 - .3 MP Anchors.
 - .4 Atlas Anchor Systems.
 - .5 Anchor Engineering.
- 2.2 SAFETY & TIE-BACK ANCHORS
- .1 Safety U-bars: mild steel, Type 300W with yield strength of 300MPa hot dipped galvanized to CSA G164. U-bar to be not less than 19mm diameter material with 38mm eye opening; Model PBE75-0000 by Pro-Bel or equivalent by other listed manufacturer.

- .2 Securement bolts: mild steel, Type 300W with yield strength of 300MPa, hot dipped galvanized to CSA G164.
- .3 Hollow steel section (HSS) piers: galvanized steel as above with yield strength of 350MPa. Wall thickness to suit application.
- .4 Base plate and all other sections: galvanized mild steel as above with yield strength of 300MPa. Thickness and securement to suit application.
- .5 Seamless spun aluminum flashing: Type 6061-T6 alloy to ASTM B221 with deck flange flashed in to CRCA recommendations. Seal top of aluminum flashing with detachable watertight stainless steel cap.
- .6 Miscellaneous bolts, nuts and washers: mild steel, Type 300W with yield strength of 300MPa, hot dipped galvanized to CSA-G164 or Type 304 stainless steel with yield strength of 240MPa.

2.3 HORIZONTAL CABLE LIFELINE SYSTEM

- .1 Hollow steel (HSS) pier supports: galvanized mild steel as above with yield strength of (50KSI) 300MPa. Wall thickness to suit application.
- .2 Base plate and all other sections: galvanized mild steel as above with yield strength of (44KSI) 300MPa. Thickness and securement to suit application.
- .3 Securement bolts: mild steel, Type 300W with yield strength of (44KSI) 300MPa, hot dipped galvanized to CSA G164.
- .4 Safety U-bars: mild steel, Type 300W with yield strength of (44KSI)300MPa, hot dipped galvanized to CSA G164. U-bar to be not less than (3/4")19mm diameter material with (1½")38mm eye opening.
- .5 Seamless spun aluminum flashing (for steel pier supports): Type 6061-T6 alloy to ASTM B221 with deck flange flashed in to CRCA recommendations. Seal top of aluminum flashing with conformable mastic tape and torch applied heat-shrink rubber collar flashing.
- .6 Miscellaneous bolts, nuts and washers: mild steel, Type 300W with yield strength of (44KSI) 300MPa, hot dipped galvanized to CSA G164 or Type 304 stainless steel with yield strength of (35KSI) 240MPa.
- .7 Double Lanyard (DL) Horizontal Lifeline
 - .1 Cable: (1/2") 13mm dia. galvanized steel with minimum breaking strength of (19,125lbs) 85kN, complete with matching permanently swaged or mechanically swaged cable ends.

- .2 Data plate: cable system entry points to be equipped with prominently displayed non-corrosive data plate clearly stating Maximum Service Capacity and Number of Users.
- .3 Tensioner: steel turnbuckle, same material as cable.
- .4 Harness: manufacturer's standard full body harness with double lanyard and shock absorbers.

3 EXECUTION

3.1 EXAMINATION

- .1 Examine surfaces and areas upon which the work of this section depends. Report to the Contractor in writing, defects of work prepared by other trades and other unsatisfactory site conditions, which would cause defective installation of products, or cause latent defects in workmanship and function.
- .2 Verify site dimensions.
- .3 Commencement of work will imply acceptance of conditions on site.

3.2 INSTALLATION

- .1 Install equipment in accordance with approved shop drawings and manufacturer's recommendations.
- .2 Co-ordinate installation with work of related trades.
- .3 Install all work true, level, tightly fitted and flush with adjacent surfaces as required.
- .4 Deform threads of tail end of anchor studs after nuts have been tightened to prevent accidental removal or vandalism.
- .5 Structure to receive safety anchors to have adequate bearing surface as indicated on shop drawings.

3.3 FINAL ADJUSTING AND INSPECTION

- .1 Adjust and leave equipment in proper working order.
- .2 Complete "Initial Inspection – Certification for Use" form included in Equipment Manual & Inspection Log Book.

3.4 TESTING

- .1 All anchors relying upon chemical adhesive fasteners to be 100% tested on site using load cell test apparatus in accordance with manufacturer's recommendations.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide window blinds as follows:
 - .1 Manual vertical sun screen shades
 - .2 Manual vertical sunscreen/room darkening shades

1.3 REFERENCES

- .1 ASTM E84; Surface Burning Characteristics of Building Materials.
- .2 NFPA 701; Standard Methods Of Fire Tests For Flame Propagation Of Textiles And Films.
- .3 ASTM E162; Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

1.4 DESIGN CRITERIA

- .1 Fabric for blinds to have flame-spread ratings and degree of flame resistance required by the National Fire Code of Canada.
 - .1 Flame Spread Rating: less than 25.

1.5 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.
- 1.6 SAMPLES
 - .1 Submit one representative working sample of each type blind in accordance with Section 01 30 00.
 - .2 Submit duplicate sample sets of manufacturer's standard fabrics for selection by Consultant.
- 1.7 SHOP DRAWINGS
 - .1 Submit shop drawings in accordance with Section 01 30 00.
 - .2 Indicate dimensions in relation to window jambs, operator details, head and sill conditions between adjacent blinds corner conditions anchorage details, hardware and accessories details.
- 1.8 MOCK-UP
 - .1 Construct one representative mock-up of each type of roller shade installation (manual and motorized) in accordance with Section 01 30 00.
 - .2 Mock-up shall consist of complete installed shades, in location as directed, indicating specified finish, trim, and installation.
 - .3 Allow for review by Consultant before proceeding with work. If acceptable to Consultant, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of the finished work.
- 1.9 CLOSEOUT SUBMITTALS
 - .1 Operations and Maintenance Data
 - .1 Submit data for inclusion into Operations and Maintenance manuals in accordance with Section 01 78 00.

- .2 Include methods for maintaining installed products, methods of cleaning fabrics, and methods of adjustment.

1.10 EXTENDED WARRANTY

- .1 Submit a manufacturer's warranty certificate in the name of the Owner, warranting the Products specified under this section against defects in material or manufacture for a period of Two (2) years from Date of Substantial Performance.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 Sun Glow Window Coverings of Canada Ltd.
- .2 HunterDouglas (Nysan Solar Control).
- .3 Altex SunProject Inc.
- .4 Legrand - Solarfective Products Ltd.

2.2 ROLLER SHADES

- .1 Manual Sunscreen Roller Shades (**WS-1**): chain drive manual sun screen roller shades, soffit-mounted, 65mm tube size, clear anodized aluminum fascias, mounting brackets, bottom bar, and end covers;
 - .1 Design: 1 blind/window.
 - .2 Sunscreen Fabric: medium weight, flame-retardent sunscreen fabric, colour/pattern as selected by Consultant from manufacturer's standard ranges.
 - .3 Shading Fabric:
 - .1 South and West exposures (3%).
 - .2 North and East exposures (5%).
 - .4 Locations: as indicated on the drawings.
 - .5 Acceptable Products
 - .1 V-Series Manual by Sun Glow.
 - .2 RB-500 by Hunter Douglas.
 - .3 Moduline 105 Lite-Lift by Altex SunProject.
 - .4 Teleshade by Legrand - Solarfective.
- .2 Manual Sunscreen / Room Darkening Roller Shades (**WS-2**): chain drive, manual dual roller sunscreen / room-darkening shades, soffit-mounted, 65mm tube size, clear anodized aluminum fascias, mounting brackets, bottom bar, and end covers;
 - .1 Design: 1 blind/window.
 - .2 Sunscreen Fabric: medium weight, flame-retardent sunscreen fabric, colour/pattern as selected by Consultant from manufacturer's standard ranges.
 - .3 Shading Fabric:
 - .1 South and West exposures (3%).
 - .2 North and East exposures (5%).
 - .4 Room Darkening Fabric: Black-out material; fiberglass coated fabric, 12 mils thick, 441g/m² minimum, washable and colorfast, to ASTM E-84, ASTM E-162, and NFPA 701. Colour as selected by Consultant from manufacturer's standard ranges.
 - .5 Locations: as indicated on the drawings.
 - .6 Acceptable Products

- .1 Gemini Dual Shade System, by Sun Glow.
 - .2 RB-500 Dual Shade by Hunter Douglas.
 - .3 Moduline 105 Lite-Lift Dual by Altex SunProject.
 - .4 Dual Teleshade by Legrand - Solarfective.
- 2.3 FABRICS
- .1 Construction of shadeband includes fabric, external bottom bar, and attachment of the shadeband to the roller tube:
 - .2 Fabric shade cloths shall be woven of vinyl-coated polyester yarn consisting of single thickness non-raveling vinyl fabric, comprising of 20-25% polyester and 75-80% reinforced vinyl (PVC), and dimensionally stable.
 - .3 Flame retardance: Fabric shall be certified by independent laboratory to pass the small scale vertical burn requirements test; CAN/ULC-S109-M87 and NFPA 701.
 - .4 Sunscreen Shadecloth Selections: colours as selected by the Consultant;
 - .1 Sun Glow
 - .1 5% Shadecloth: CS-105
 - .2 3% Shadecloth: CS-103
 - .2 Hunter Douglas
 - .1 5% Shadecloth: Shearweave 5000 Series
 - .2 3% Shadecloth: Shearweave 4000 Series
 - .3 Legrand - Solarfective
 - .1 5% Shadecloth: Solarshield 500 Series
 - .2 3% Shadecloth: Solarblock 300 Series
 - .4 Altex SunProject
 - .1 5% Shadecloth: SC-3400 Series
 - .2 3% Shadecloth: SC-2000 Series
 - .5 Room Darkening Shadecloth Selections: colours as selected by the Consultant;
 - .1 Legrand - Solarfective: SolarStop Blackout Fabric - 4 Ply (1 ply Woven Fibreglass, 3 ply PVC Film).
 - .2 Altex SunProject: BO-100 Blackout Fabric.
 - .3 Hunter Douglas: ShearWeave 7000.
 - .4 Sun Glow: EZ900 Blackout.
 - .6 Mounting Type:
 - .1 Ceiling Mounted: concealed pocket mount as detailed on the drawings.
 - .7 Shade Orientation:
 - .1 Regular-roll, shadecloth to roll at window side of roller.

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- 2.4 SHADE ROLLER TUBE
- .1 Rigid roller tubes shall be extruded aluminum with reinforced internal ribs to provide maximum span without tube deflection. Tube sizes will depend on shade size, as recommended by manufacturer.
- 2.5 TUBE END PLUG
- .1 Internal tension idler limiter automatically adjusts and controls the amount of torque being generated for constant smooth operation of the shade system. The limiter must automatically release during down-travel, and automatically engage during up-travel of the shade system.
- 2.6 DRIVE
- .1 Shall consist of a heavy duty commercial grade sprocket. Drive sprocket must contain a planetary gear system for increased performance, speed ratio, smoothness, and balance to the shade system. Must provide for infinite positioning of shade system.
- 2.7 OPERATING CHAIN (MANUAL SHADES)
- .1 Shall be No. 10 qualified heavy duty stainless steel bead chain 90 lb load test formed in a continuous loop. With stops at highest and lowest positions to prevent overwinding and unrolling.
- 2.8 EXTERIOR HEMBAR
- .1 Shall be extruded aluminum with recess to secure fabric without visible seams. End plugs shall be screwed securely on ends showing no exposed aluminum. Design allowing shade to be pulled on the hembar. Finish/colour shall match fascia.
- 2.9 MOUNTING BRACKETS
- .1 Shall be 0.60" galvanized steel snap on brackets for ceiling, wall, or recessed mount in ceiling.
- 2.10 FASCIAS
- .1 One piece 1.7mm thick aluminum front or bottom fascias.
 - .2 Finish: clear anodized aluminum, or custom painted in colour selected by Consultant.
- 2.11 GUIDE CHANNELS
- .1 One piece 1.7mm thick aluminum jamb guide channels for room darkening shades.
- 2.12 OPERATION
- .1 General
 - .1 An internal tension idler limiter automatically adjusts and controls the amount of torque being generated for constant smooth operation of the shade system. The limiter automatically releases during down-travel, and automatically engages during up-travel of the shade system.
 - .2 Lifting mechanism must accommodate tension modules for maximum shade performance when necessary. The tension modules must also contain a memory lock for torque retention.

- .3 Noise reduction seals must be used for sound isolation and absorption of the mechanism.
- .4 Drive sprocket must contain a planetary gear system for increased operational performance, speed ratio control, smoothness of lift, and balance to the chain and shade system.
- .2 Manual Drive
 - .1 Shade to be able to move freely when pulled on chain. The unit shall consist of a tension activated lifting mechanism. The lifting mechanism must contain a memory lock which shall maintain pre-tensioning when the shade is removed from the cassette bracket, and shall not require re-tensioning when shade is re-inserted into the bracket. The roller mechanism must be reversible for future alterations and maintenance on site.

3 EXECUTION

3.1 INSTALLATION

- .1 Install bracket mounted blinds in accordance with manufacturer's instructions.
- .2 Install blinds square, plumb, true to line with operable parts adjusted for correct function.
- .3 Secure head rails with stainless steel screws. Use non corrosive metal fasteners for installation, concealed in final assembly. Install all bottom panels, fascias, and end panels to provide concealed installation.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide custom fabricated stainless steel casework and associated hardware.
 - .1 Stainless steel counters.
 - .2 Stainless steel backsplashes.

1.3 REFERENCES

- .1 SEFA 8: Laboratory Furniture – Casework, Shelving and Tables Guidelines
- .2 ADA (ATBCB ADAAG) Americans with Disabilities Act Accessibility Guidelines
- .3 Americans with Disabilities Act (ADA)

1.4 SUBMITTALS

- .1 Make submittals in accordance with Section 01 30 00.
- .2 Product Data:
 - .1 Drawings shall include data and details for construction of the laboratory casework as well as information regarding the name, quantity, type and construction of materials (such as hardware, gauges, etc), that will be used to complete the project.
- .3 Shop Drawings:

- .1 The laboratory casework manufacturer shall furnish shop drawings illustrating the layout and placement of all laboratory casework shelving and countertops.
 - .2 Indicate full details of all brackets and supports.
 - .3 Indicate the type and location of all service fittings and associated supply connections.
 - .4 Preparation instructions and recommendations.
 - .5 Storage and handling requirements and recommendations.
 - .6 Installation methods.
- .4 Selection Samples:
- .1 Submit the following:
 - .1 Manufacturer's standard stainless steel finish, minimum sample size (2 inches by 3 inches) 50mm x 76mm.
 - .2 One Countertop backsplash and finished edge.
- .5 Quality Assurance/Control
- .1 Design Data/Test Reports: Manufacturer shall submit test data and design criteria which are in compliance with the project specifications.
 - .2 Certificates: All certifications required in the specifications shall be submitted with the original submittal package under separate cover. Certificates must be provided with the signature of a qualified individual of the supplier.
 - .3 Manufacturers' Instructions: Provide manufacturer's instructions for installation and maintenance of all products provided and installed within this section. Instructions will be in bound form, tabbed and organized by section number.
- 1.5 QUALITY ASSURANCE
- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .3 Documentation

- .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.

- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

- 1.6 DELIVERY, STORAGE AND HANDLING
 - .1 Packaging, Shipping, Handling and Unloading
 - .1 Packaging: Products shall have packaging adequate enough to protect finished surfaces from soiling or damage during shipping, delivery and installation.

 - .2 Delivery: Casework delivery shall only take place after painting, utility rough-ins and related activities are completed that could otherwise damage, soil or deteriorate casework in installation areas.

 - .3 Handling: Care, such as the use of proper moving equipment, experienced movers, etc., shall be used at all times to avoid damaging the casework. Until installation takes place, any wrapping, insulation or other method of protection applied to products from the factory will be left in place to avoid accidental damage.

 - .2 Acceptance at Site:
 - .1 Casework will not be delivered or installed until the conditions specified under Part 3, Installation section of this document have been met.

 - .3 Storage:
 - .1 Casework shall be stored in the area of installation. If, prior to installation, it is necessary for casework to be temporarily stored in an area other than the installation area, the environmental conditions shall meet the environmental requirements specified under the Project Site Conditions article of this section.

 - .4 Waste Management and Disposal:
 - .1 The supplier of the laboratory casework is responsible for removing any waste or refuse resulting from the installation of, or work pertaining to laboratory casework; thereby leaving the project site clean and free of debris. Trash container(s) to be provided by others.

- 1.7 WARRANTY

- .1 Furnish a written warranty that Work performed under this Section shall remain free from defects as to materials and workmanship for a period of two (2) years from date of shipment. Defects in materials and workmanship that may develop within this time are to be replaced without cost or expense to the Owner.

2 PRODUCTS

2.1 MATERIALS

- .1 Stainless Steel:
 - .1 Sheet: ASTM A240, Type 304 or 316 alloy.
 - .2 Finish: Unless otherwise indicated, AISI No. 4 Brushed Finish.
- .2 Galvanized Sheet Steel:
 - .1 Commercial quality galvanized sheet steel to ASTM 653, Designation Z275.
- .3 Sealant:
 - .1 One component, RTV silicone sealant. Colour to suit application.

2.2 CONSTRUCTION

- .1 Use the following minimum steel thicknesses for manufacturing:
 - .1 (11 Ga) 3mm leveling bolt gusset plates.
 - .2 (16 Ga) 1.5mm for tubular rails, legs for tables, gusset plates, cabinet top and intermediate horizontal rails.
 - .3 (16 Ga) 1.5mm for counter tops and support brackets.
- .2 Countertops & Backsplashes
 - .1 Fabrication: All factory welds shall be made using the TIG process. Filler rod shall be of the same composition as the base material.
 - .2 Tops: Form tops with 1.25" high (32mm) edges with 0.5" (12mm) return flange. Reinforce with particleboard wood core or metal hat channels as required. Form edges, flanges and backsplashes integrally from one sheet of steel. Intersections between backsplashes and work surface shall be radiused a minimum of 0.375" (9mm).
 - .3 Sink Tops: Form tops with 1.25" high (32mm) edges with 0.5" (12mm) return flange. Marine edges shall integrally formed on all edges. Marine edges shall be 1" (25mm) wide and 0.25" (6mm) high. Work surface shall be reinforced with wood core or metal hat channels as required. Form edges, flanges and backsplashes integrally from one sheet of steel. Intersections between backsplashes and work surface shall be radiused a minimum of 0.375" (9mm).

- .4 Sink Bowls: Sink bowls shall be made of the same material as the work surface and shall be of equal or greater thickness. Sinks bowls shall be formed from one piece of steel with all inside corners radiused. Welds shall be hammered, ground and polished to produce a smooth, invisible joint. Sinks shall be welded into the work surface and welds shall be ground and polished to produce a smooth, invisible joint.
- .5 Joints: Factory welds shall be ground and polished to provide an invisible joint. Field connections shall be mechanical "tongue and groove" interlocking design with concealed bolts to provide a hairline seam.
- .6 Sound Deadener: Countertops and sinks shall have sound deadening material applied as required to the underside. Nominal thickness shall be 0.062" (1.5mm). Sound deadener shall be waterborne, non-flammable and shall contain no volatile organic compounds.
- .3 Service Fittings and Fixtures:
 - .1 Refer to Mechanical Drawings and Specifications.

3 EXECUTION

3.1 GENERAL

- .1 Examine the site and take all measurements necessary to ensure accurate and proper fitting of this work into the building.

3.2 INSTALLATION

- .1 Countertop Installation:
 - .1 Fabricate countertops in lengths according to drawings, with ends abutting tightly and sealed with corrosion resistant sealant.
 - .2 Tops will be anchored to base casework in a single true plane with ends abutting at hairline joints with no raised edges at joints.
 - .3 Joints shall be factory prepared having no need for in-field processing of top and edge surfaces.
 - .4 Joints shall be dressed smoothly, surface scratches removed and entire surface cleaned thoroughly.

3.3 PROTECTION

- .1 Cover finished surfaces with heavy kraft paper or put in cartons during shipment. Protect installed laminated surfaces by approved means. Do not remove until immediately before final inspection.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide solid surfacing fabrications including, but not limited to, the following:
 - .1 Washroom countertops with seamed undermount bowls

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 30 00, indicating all dimensions, component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work.
- .2 Submit duplicate 50 x 50mm samples of each colour and finish in accordance with Section 01 30 00.
- .3 Submit manufacturer's instructions for care and maintenance of solid surface materials including repair instructions Include in Maintenance manual.

1.4 TOLERANCES

- .1 Variation in component size: ± 3 mm.
- .2 Location of openings: ± 3 mm from indicated location.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Do not deliver components to site until cabinetry or substrates are ready for installation. Store materials indoors prior to installation.

1.6 WARRANTY

- .1 Provide manufacturer's written warranty against defects in materials and workmanship under normal usage, for a period of ten (10) years from Date of Substantial Completion. Warranty shall provide for all material and labour to repair or replace defective materials.

2 PRODUCTS

2.1 ACCEPTABLE PRODUCTS

- .1 Corian®, by DuPont Canada.
- .2 Formica® Solid Surfacing, by Formica Canada Inc.
- .3 Staron®, by LOTTE Advanced Materials, LaPalma CA.
- .4 Hanex® Solid Surfaces, by Hanwha L&C.

2.2 MATERIALS

- .1 Acrylic: Homogeneous acrylic; not coated or laminated; meeting ANSI-Z124.3 & Z124.6, Type 6. Superficial damage to a depth of 0.25mm shall be repairable by sanding and polishing.
 - .1 Colour/Finish: as selected by the Consultant

2.3 COMPONENTS

- .1 Washroom Countertops with Integral Bowls: molded countertop of solid polymer material, complete with integrally molded bowls of solid polymer material; edge details as indicated on the Drawings. Provide with cove backsplashes as shown on the Drawings.

2.4 PERFORMANCE CHARACTERISTICS

PROPERTY	REQUIREMENT	TEST PROCEDURE
	(min or max)	
Tensile Strength	35MPa min.	ASTM D638
Flexural Strength	48MPa min	ASTM D790
Elongation	0.3% min.	ASTM D638
Hardness	90-Rockwell "M" scale min. 52-Barcol Impresser min.	ASTM D758 ASTM D2583
Thermal Expansion	3.5×10^{-5} in/in/°C max.	ASTM D696
Color Stability	No change, 100 hours min.	NEMA LD3-3.10
Wear and Cleanability	Passes	ANSI Z124.3
Abrasion Resistance	No loss of pattern max. weight loss (1000cycles) =0.9g.	NEMA LD3-3.01 ANSI Z124.3
Boiling water Surface Resistance	No Change	NEMA LD3-3.05

High Temperature Resistance	No Change		NEMA LD3-3.06	
Impact Resistance Notched Izod Gardner	1.06N min. 40N min.		ASTM D256, Method A ASTM D3029	
Stain Resistance	Passes		ANSI Z124.3	
Weatherability	No change, min. 1000 hours		ASTM D1499	
Fungi and Bacteria	No Attack		ASTM G21, ASTM G22	
Specific Gravity	1.6 min			
Water Absorption Weight (% max.)	24 hrs. 0.05 0.10	Long Term 0.50 0.90	ASTM D570	
Flammability	ASTM E84			
SOLID COLOURS				
	6mm	13mm	19mm	
Flame spread	25 max	25 max	25 max	
Smoke Developed	30 max	30 max	30 max	
Class	1	1	1	
PARTICULATE PATTERNS				
	6mm	13mm	19mm	
Flame spread	25 max	25 max	25 max	
Smoke Developed	30 max	30 max	30 max	

2.5 ACCESSORIES

- .1 Joint adhesive: Manufacturer's standard two-part adhesive to create inconspicuous, non-porous joints, with a chemical bond.
- .2 Panel Adhesive: Manufacturer's standard neoprene-based panel adhesive meeting ANSI-A136.1-1967, UL® listed.
- .3 Sealant: Manufacturer's standard mildew-resistant, FDA/UL® recognized silicone sealant in colour matching or clear formulations.

2.6 FABRICATION

- .1 Fabrications to be performed by a Manufacturer Certified fabricator/installer.
- .2 Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and Manufacturer's requirements.

- .3 Form joints between components using manufacturer's standard joint adhesive. Joints shall be inconspicuous in appearance and without voids. Attach 50mm wide reinforcing strip of solid surface material under each joint.
- .4 Provide holes and cutouts for plumbing and bath accessories as indicated on the drawings.
- .5 Rout and finish component edges to a smooth, uniform finish. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.
- .6 Finish: All surfaces shall have uniform finish.
 - .1 Matte, with a gloss rating of 5 - 20.
- .7 Thermoforming: Comply with forming data from manufacturer.
 - .1 Construct matching molds of plywood to form component shape.
 - .2 Form pieces to shape prior to seaming and joining.
 - .3 Cut pieces larger than finished dimensions. Sand edges. Remove all nicks and scratches.
 - .4 Heat entire component uniformly between 135-163°C during forming.
 - .5 Prevent blistering, whitening and cracking during forming.
- .8 Cove backsplashes: Fabricate 13mm radius cove at intersection of counters and backsplashes. Form backsplashes using 13mm material. Fabricate in shop or field.

3 EXECUTION

3.1 INSTALLATION

- .1 Install components plumb and level, in accordance with approved shop drawings and product installation details.
- .2 Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work. Keep components and hands clean when making joints.
- .3 Adhere undermount bowls to countertops using manufacturer's recommended adhesive and mounting hardware.
- .4 Provide backsplashes and endsplashes as indicated on the drawings. Adhere to countertops using manufacturer's standard colour-matched silicone sealant.
- .5 Keep components and hands clean during installation. Remove adhesives, sealants and other stains.
- .6 Protect surfaces from damage until Date of Substantial Completion. Repair or replace damaged work that cannot be repaired to Consultant's satisfaction.

- .7 Fabricator/Installer to provide Commercial Care and Maintenance instructions, review maintenance procedures and warranty with the Owner's head of maintenance upon completion of project.

3.2 PROTECTION

- .1 Protect completed installation from damage resulting from other trades with heavy kraft paper, or cardboard until date of final inspection.

3.3 CLEANUP

- .1 Remove all excess adhesives, sealants and other contaminants from solid surface installation and all adjacent surfaces. Leave completed installation clean and ready for final inspection.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide recessed floor grilles.

1.3 REFERENCES

- .1 Aluminum Association (AA); DAF-45, Designation System for Aluminum Finishes.
- .2 ASTM B209; Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 ASTM B221M; Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
- .4 CAN3-S157; Strength Design in Aluminum.
- .5 CSA W59.2; Welded Aluminum Construction.
- .6 ASTM D2047; Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
- .7 ASTM E648; Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication

of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

.2 Installation/Application

.1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.

.3 Documentation

.1 If requested, submit documentation to support the competency of firms and personnel.

.4 Pre-application Meeting

.1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:

.1 Contractor (Site Superintendent & Project Manager)

.2 Application Subcontractor (Site Foreman & Project Manager)

.3 Product Manufacturer and/or Distributor (Technical Representatives)

.4 Related Subcontractors whose work is affected by that of this Section.

1.5 SUBMITTALS

.1 General: Submit the following in accordance with Section 01 30 00.

.2 Product Data: for each type of floor grid and frame specified, including manufacturer's specifications and installation instructions.

.3 Shop Drawings: in sufficient detail showing layout of grid and frame specified including details indicating construction relative to materials, direction of traffic, spline locations, profiles, anchors and accessories.

.4 Samples: Submit an assembled section of floor grid and frame members with selected tread insert showing each type of colour for exposed floor grid, frame and accessories required.

.5 Maintenance Data: manufacturer's printed instructions for cleaning and maintaining floor grids.

1.6 PERFORMANCE REQUIREMENTS

.1 Flammability: Critical Radiant Flux minimum 0.45 watts/m² Class I to ASTM E648.

.2 Slip Resistance: Coefficient of Friction, minimum 0.60 for accessible routes in accordance with ASTM D2047.

- .3 Standard rolling load performance is (500 lb) 227kg / wheel (load applied to a solid (5" x 2") 127mm x 51mm wide polyurethane wheel, 1000 passes without damage).

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to the project site ready for use and fabricated in as large sections and assemblies as practical, in unopened original factory packaging clearly labeled to identify manufacturer.

1.8 PROJECT CONDITIONS

- .1 Field measurements: Check actual openings for grids by accurate field measurements before fabrication. Record actual measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.
- .2 Coordinate frame installation with concrete construction to ensure recess and frame anchorage are accurate and that the base is level and flat. Defer frame installation until building enclosure is complete and related interior finish work is in progress.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 C/S Construction Specialties Inc.
- .2 Bolar Inc.
- .3 KN Crowder Manufacturing Inc.
- .4 McGill Manufacturing Ltd.

2.2 MATERIALS

- .1 Aluminum Members: Alcan 6063-T5 alloy and temper.
- .2 Extruded Aluminum: to ASTM B221.
- .3 Sheet Aluminum: ASTM B209.
- .4 Screws, bolts and fasteners: 300 series stainless steel or 400 series stainless steel cadmium plated.

2.3 FLOOR GRIDS

- .1 Description: fully recessed floor grid manufactured from 6063-T5 alloy extruded aluminum, (1-13/16") 46mm depth, with serrated aluminum inserts.
- .2 Acceptable Products
 - .1 PEDIGRID SA-G1, by C/S Construction Specialties Inc.

- .2 BLA-1 by Bolar Inc.
- .3 FG-5 by KN Crowder Manufacturing Inc.
- .4 AG-8000 by McGill Manufacturing Ltd.

2.4 GRID FRAMES

- .1 Aluminum Angle Frame: CS Type LB - (1-13/16") 46mm deep recessed frame with (1/2") 13mm wide exposed surface. Latex leveling screed by installer to ensure level base.

2.5 LOCK-DOWN MECHANISM

- .1 Surface Lock Down: Type 304 stainless steel, surface-mounted device to secure the Grille to frame.

2.6 FINISH

- .1 Anodized: Class II to AA-M12C22A3, #17 Clear.

2.7 FABRICATION

- .1 Fabricate units square and true with maximum tolerance of plus or minus (1/16") 1.5mm for units with a diagonal measurement of (6'-0") 1830mm or less and plus or minus (1/8") 3mm for units with a diagonal measurement over (6'-0") 1830mm.
- .2 Face dimensions detailed are maximum permissible sizes.
- .3 Brace frames to maintain squareness and rigidity during shipment and installation.
- .4 Provide all internal reinforcing as required for the proper structural design and support of the framing system.
- .5 All joints shall be accurately machined, assembled and sealed to provide neat joints.

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
- .2 Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- .1 Manufacturer shall offer assistance and guidance to provide a template of irregular shaped grid assemblies to ensure a proper installation.

3.3 INSTALLATION

- .1 Install the work of this section in strict accordance with the manufacturer's recommendations.
 - .2 Set grid type at height recommended by manufacturer for most effective cleaning action.
 - .3 Coordinate top of grid surfaces with bottom of doors that swing across to provide ample clearance between door and grid.
- 3.4 CLEANING
- .1 Clean the tread surface and recessed well as frequently as possible to reduce the effects of accumulated soiling that may hinder performance and lifetime.
- 3.5 PROTECTION
- .1 After completing required frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses, and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and project is near time of substantial completion.
 - .2 Defer installation of floor grids until time of substantial completion of project.

END OF SECTION

Part 1 - General

1.1 General Requirements

- .1 This Section covers:
 - .1 The design, supply, complete installation, verification, and testing of the sprinkler system.
 - .2 The installation, verification, and testing of the residential kitchen hood suppression system.
 - .3 The supply and installation of fire extinguishers and fire extinguisher cabinets.
- .2 Provide all labour, materials, equipment, services, and accessories required to complete the work specified and to ensure complete and operational systems.
- .3 Provide all devices and switches for the systems to be completely tied into the fire alarm system.
- .4 The systems shall be installed as per all codes and requirements.
- .5 The Sprinkler Contractor shall be a Red Seal certified sprinkler and fire protection installer, in good standing with C.A.S.A.

1.2 Reference Standards

- .1 Ontario Building Code
- .2 U.L.C.
- .3 N.F.P.A.

1.3 Coordination

- .1 This Contractor shall coordinate with other trades prior to the installation of work covered under this contract.
- .2 Such trades include but are not limited to:
 - .1 Coordinate with sheet metal trade for ductwork obstructions.
 - .2 Coordinate with electrical trade for lighting obstructions.
 - .3 Coordinate with heating and plumbing trades for pipe obstructions.
 - .4 Coordinate with General Contractor regarding building construction.
- .3 Additional material, cutting and patching required resulting from lack of coordination are the responsibility of this Contractor with no additional cost to the Owner.

1.4 Design

- .1 The Contractor shall prepare design drawings in AutoCAD complete with pipe sizing and hydraulic calculations as per N.F.P.A requirements. Submit complete package to Consultant for review and to City for building permit.
- .2 Perform certified accurate tests for water supply information or obtain from the Fire Department or Water Utility where available. Water tests shall be maximum one (1) year old. Where available tests reports are greater than one (1) year, the Contractor shall perform their own water tests.
- .3 Submit water test results with design submission. Water tests shall be submitted on company letterhead, dated and include name and signature of technician who performed the test.
- .4 Design to have minimum 15 percent safety factor on pressure requirements and minimum 25 percent safety factor on flow requirements.

1.5 Submittals

- .1 Submit design drawings, hydraulic calculations sealed and signed by a qualified Professional Engineer registered in Ontario, to the Consultant for review prior to construction. Water tests shall accompany the submission.
- .2 The design drawings and submission details to contain all information as outlined in N.F.P.A. 13 and as required by the authorities having jurisdiction.
- .3 Drawings shall be prepared in AutoCAD format.
- .4 Submit shop drawings for all components of the fire protection system including but not limited to:
 - .1 Backflow Preventer complete with pressure loss chart
 - .2 Alarm Valve complete with pressure loss chart (if used)
 - .3 Excess Pressure Pump (if used)
 - .4 Zone Valves / Flow Switches
 - .5 Fire Department / Siamese Connection
 - .6 Other Valves including check, gate
 - .7 Other accessories including switches, sensor, and gauges
 - .8 Sprinkler Heads (must be type used in hydraulic calculations)
 - .9 Sprinkler Pipe and Fittings (must be type used in hydraulic calculations)

.10 Sprinkler Heat Guards

Note: All pipe and components shall be equal to pipe and components used by Designer of Sprinkler drawings and hydraulic calculations.

- .5 Submit fire extinguishers and fire extinguisher cabinets.
- .6 Submit design drawings and hydraulic calculations, as reviewed and accepted by the Consultant, to the local Building Department for approval.
- .7 Operation and Maintenance Data:
 - .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
 - .2 Operation and maintenance data shall be included in the maintenance manual.
- .8 Submit completed Material and Test Certificate(s), signed and dated by the Contractor's representative and witness, at the completion of the project to the Consultant.

1.6 Maintenance Manuals

- .1 Refer to Section 23 05 02 – Documents and Manuals.
- .2 Include the following into the maintenance manuals:
 - .1 Sign-off letter from System Design Engineer.
 - .2 Material and Test Certificates
 - .3 Sealed, Signed and Consultant reviewed drawings and calculations
 - .4 Record drawings
 - .5 All stamped reviewed shop drawings
 - .6 Operating and Maintenance Instructions
 - .7 Warranty Letter

Part 2 – Products

2.1 General

- .1 This Contractor shall provide all labour and materials for a complete and operational sprinkler system in conformance with N.F.P.A. 13.
- .2 This Contractor shall provide all fire extinguishers and fire extinguisher cabinets.
- .3 This Contractor shall provide all zone flow switches, water and air trouble

monitoring devices, and supervisory tamper switches on all gate valves to allow for complete and adequate monitoring by fire alarm system.

- .4 All devices to be fully electrically supervised. All wiring by Division 26. Coordinate with Division 26.

2.2 Pipe and Fittings

- .1 Pipe and fittings shall meet the requirements of N.F.P.A. 13, Standard for the Installation of Sprinkler Systems.
- .2 All pipe and fittings shall be listed by N.F.P.A., F.M., and U.L.C.
- .3 Pipe:
 - 1. Main header – Steel schedule 40
 - 2. Other Lines – Steel schedule 10 or steel schedule 40.
 - 3. Light wall pipe shall be steel, U.L.C. listed, manufactured to meet A.S.T.M. A 795 Type E, Grade A, and rated at 300 p.s.i. working pressure equal to Schedule 10. 3 millimeters wall for 63 millimeters (2½ inches) to 100 millimeters (4 inches), 3.5 millimeters wall for 150 millimeters (6 inches) and up.
 - 4. Thicker wall pipe shall be steel, U.L.C. listed, manufactured to meet A.S.T.M. A 135, Grade A., and rated at 300 p.s.i. working pressure equal to Schedule 40.
 - 5. Flexible piping is not acceptable.
- .4 Fittings:
 - .1 Forged steel – welded, flanged
 - .2 Malleable steel - threaded, flanged, grooved
 - .3 Grooved fittings shall conform to A.S.T.M. A47 and A.S.T.M. A536 and be listed U.L.C., F.M. and N.F.P.A..
 - .4 Cast iron flanged fittings shall conform to A.N.S.I. B16.1, steel flanged fittings shall conform to A.N.S.I. B16.5, and butt welded fittings shall conform to A.S.T.M. A234.
 - .5 Cast iron threaded fittings shall conform to A.N.S.I. B16.4 and malleable iron threaded fittings shall conform to A.S.T.M. B16.3.
 - .6 Threaded fittings are not acceptable with schedule 10 or thin wall piping.

2.3 Pipe Supports and Hangers

- .1 Hangers shall be U.L.C. listed for use in sprinkler systems.

- .2 Adjustable, galvanized clevis pipe supports and hangers shall be used in accordance with N.F.P.A. 13.
- .3 Provide steel hanger rods, threaded both ends or continuous threaded, complete with lock nuts on both ends.
- .4 Wall Support:
 - .1 Pipe Sizes 75 millimeters (3 inches) and under: Cast iron hook, or fabricated bracket of 1 inch by 1 inch by ¼ inch angle bar.
 - .2 Pipe Sizes 100 millimeters (4 inches) and over: Welded steel bracket and wrought steel clamp.
- .5 Vertical Support:
 - .1 Steel riser clamp.
- .6 Floor Support:
 - .1 Fabricated stand and pipe clamp or saddle.

2.4 Valves

- .1 Valves shall be rated for 1200 kilopascal (175 p.s.i.) or 350 kilopascal (50 p.s.i.) above working pressure whichever is greater.
- .2 Valves 63 millimeters (2½ inches) and over shall be grooved or flanged.
- .3 All isolation valves at header to be gear operated butterfly valves.
- .4 Provide N.P.T. drain valves in locations as required complete with hose end, cap, and chain.
- .5 All valves in sprinkler header or sprinkler lines shall be supervised. Coordinate with Division 26.

2.5 Backflow Preventer

- .1 Provide backflow preventer complete with two independent acting spring loaded swing check assemblies and two valves.
- .2 Backflow preventer shall have bronze body, stainless steel springs, and three chambers complete with test cocks on each chamber.
- .3 Acceptable Manufacturers: Watts, Zurn, Ames, Conbraco

2.6 Wet Alarm Valve (where applicable to suit final system design)

- .1 Provide U.L.C. listed, FM approved automatic wet system alarm valve complete with standard trim and accessories to current N.F.P.A. standards.
- .2 Accessories to include low pressure alarm switch, pressure maintenance

switch, pressure gauges on supply and system sides, alarm test bypass, and all required fittings.

2.7 Excess Pressure Pump (where applicable to suit final system design)

- .1 Provide cast iron bronze body excess pressure pump complete with steel impellers, steel shaft, single mechanical seals, and all pressure switches and gauges.
- .2 Excess pressure pump must be rated for minimum 276 kilopascals (40 p.s.i.) in excess of normal pressure or to suit design requirements if higher.

2.8 Zone Valves

- .1 Provide U.L.C. listed and F.M. approved zone valves.
- .2 Zone valves shall be complete with:
 - .1 Butterfly shut-off valve complete with tamper switch
 - .2 Potter water flow switch

2.9 Fire Department Connection

- .1 Fire department connection shall be U.L.C. approved, polished chrome, flush mounted double inlet with 500 g.p.m. inlet capacity. Connection shall be complete with two drop clappers, body, escutcheon plate (labelled "Sprinkler"), snoots and plugs. 300 p.s.i. rated. Equal to National Fire Model 229.
- .2 Provide a listed check valve for fire department connection.
- .3 Provide approved 13 millimeters ($\frac{1}{2}$ inch) threaded automatic ball drip connection where not integral to unit.

2.10 Sprinkler Heads

- .1 Provide sprinkler heads as conditions and density require.
- .2 Provide brass upright sprinkler heads in exposed areas.
- .3 Provide white concealed sprinkler heads complete with escutcheons in all dropped ceilings.
- .4 Provide sidewall sprinkler heads at overhead doors.
- .5 Provide upright sprinkler heads complete with cages under stairs, where exposed.
- .6 All sprinkler heads to have temperature rating of 68 degrees Celsius (155 degrees Fahrenheit) unless otherwise noted or required in conformance with N.F.P.A..

- .7 Provide N.F.P.A. listed heavy duty sprinkler head guards secured by screwed clamps on:
 - .1 All sprinklers heads below 2.4 meters above finished floor.
 - .2 Other areas where heads are susceptible to damage or as noted above.

2.11 Test Connection

- .1 Provide an alarm test connection not less than 25 millimeters (1 inch) in diameter for each system, terminating in a smooth bore corrosion-resistant orifice, to provide a flow equivalent to one sprinkler head as installed on the end of the most remote branch line on the upper storey.
- .2 Test connection shall be equipped with a readily accessible 25 millimeters (1 inch) brass shut-off valve and plug or nipple and cap.

2.12 Gauges

- .1 Provide listed pressure gauges with connection not smaller than 6 millimeters ($\frac{1}{4}$ inches) at system main drain and at each fire hose cabinet on outlet side of pressure reducing valve.
- .2 Pressure gauges shall have a maximum limit not less than twice the normal working pressure.

2.13 Drainage

- .1 Provide auxiliary drains for trapped areas where required as per N.F.P.A..

2.14 Fire Extinguishers (with or without cabinets)

- .1 Cabinets and extinguishers shall be U.L.C. listed, F.M. approved, and conform to N.F.P.A. 10.
- .2 Fire extinguisher cabinets shall be recessed National Fire Equipment Limited with glass front.
- .3 Wall mounted fire extinguishers shall be complete with wall mounting bracket.
- .4 Fire Extinguishers:
 - .1 Fire extinguishers shall be U.L.C. listed and approved by local authorities.
 - .2 Fire extinguishers shall be multi-purpose, dry chemical, UL listed for Class A., B., and C. fires.
 - .3 Fire extinguishers shall have heavy duty cylinder with glossy red, corrosion resistant finish.

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- .4 2.25 kilograms (5 pounds) fire extinguishers shall be equal to National Fire Equipment ABC-050WWD with a U.L.C. rating of 3A10BC.
 - .5 4.5 kilograms (10 pounds) fire extinguishers shall be equal to National Fire Equipment ABC-100WWD with a U.L.C. rating of 6A80BC.
 - .6 Acceptable Manufacturers:
 - .1 National Fire Equipment Limited
 - .2 Flag
 - .3 Wilson and Cousins
 - .5 Cabinets
 - .1 Cabinets shall be white with baked enamel finish.
 - .2 For 2.25 kilograms (5 pounds) fire extinguishers: Equal to National Fire Equipment Model 102F, 8 inches by 17 inches by 5 inches (203 by 432 by 127 millimeters), fully recessed, 22 gauge steel tub, 16 gauge steel door and trim with ¼ inch (6 millimeters) return frame, full length semi-concealed piano hinge, flush stainless steel door latch, baked enamel paint, glazed with 3/16 inch (5 millimeters) clear glass 4 inches by 13 inches (101 by 330 millimeters).
 - .3 For 4.5 kilograms (10 pounds) fire extinguishers (fully recessed in 6 inches walls): Equal to National Fire Equipment Model C950-3, tub size 9 inches by 24 inches by 6 inches (229 by 610 by 152 millimeters), fully recessed, 22 gauge steel tub, 16 gauge steel door and trim with ¼ inch (6 millimeters) return frame, full length semi-concealed piano hinge, flush stainless steel door latch, baked enamel paint, glazed with 3/16 inch (5 millimeters) clear glass 5 inches by 20 inches (127 by 508 millimeters).
 - .4 For 4.5 kilograms (10 pounds) fire extinguishers (semi-recessed in 4 inches walls): Equal to National Fire Equipment Model C950-1, tub size 14½ inches by 30 inches by 4 inches (368 by 762 by 100 millimeters), semi-recessed, 18ga steel tub, 14ga steel door & trim with 1 inch (25 millimeters) return frame, full length semi-concealed piano hinge, flush stainless steel door latch, baked enamel paint. Front section to have full 2 inch (51 millimeters) adjustment to wall. Viewing area to be provided with a plastic bubble canopy.

2.15 Tags, Nameplates, and Data Plates

- .1 Provide engraved brass tags identifying all valves.

- .2 Provide riser nameplates on all zone risers.
- .3 Refer to Section 22 05 53 – Identification for Plumbing Piping and Equipment.

2.16 Maintenance and Accessories

- .1 Provide maintenance equipment, spare parts, and cabinets as per N.F.P.A. 13 and as recommended by the manufacturer
- .2 Provide a red, metal, lockable spare head cabinet to be mounted on the wall complete with spare heads of same manufacturer and model as installed and spare wrench. Quantity of heads and size of cabinet shall be as per N.F.P.A. 13 requirements.

Part 3 – Execution

3.1 General Installation

- .1 Install the sprinkler system in accordance with codes and regulations as listed above, and as per manufacturers recommendations
- .2 Do not conceal any work prior to Inspection and approval by Consultant and reviewing authorities.
- .3 Do not trap any part of the system unless approved by the Consultant. Provide drum drip or low point drains for trapped areas.
- .4 Provide signage as required by Fire Department and authorities having jurisdiction.
- .5 Label all drains valves and clearly mark on Record Drawings.

3.2 Sprinkler System

- .1 Sprinkler piping shall be located so as not to interfere with other equipment, ductwork, and piping. Confirm with other trades prior to installation. Where piping has to be relocated it shall be done at no extra cost to the Owner.
- .2 Sprinkler piping shall be installed in straight lines parallel to building structure and shall not interfere with head room.
- .3 Confirm all valves and switches are monitored. Coordinate with Division 26.

3.3 Backflow Preventer

- .1 Backflow preventers shall have minimum 1 meter (3 foot) clearance above the device for connection and operation of testing equipment.

3.4 Wet Alarm Valve

- .1 Maintain acceptable clearance around valve for service.
- 3.5 Excess Pressure Pump (where required).
 - .1 Provide mounting brackets as required.
 - .2 Provide electrical requirements to Electrical Contractor.
- 3.6 Fire Department Connection
 - .1 Locate fire department connection so that hose lines can be readily and conveniently attached without interference from nearby objects. Confirm location of fire department connection in the field and confirm it is within 45 meters (150 feet) of nearest fire hydrant.
 - .2 Isolate fire department connection from main header with a listed swing check valve in the line. Check valve should be located for easy accessibility and to minimize freezing potential.
- 3.7 Sprinkler Heads
 - .1 Confirm exact head layout based on new layout, lighting, grilles, diffusers and other ceiling devices.
 - .2 Temperature ratings of sprinkler heads shall suit specific area with minimum margin of 10 degrees Celsius. Mechanical equipment shall be considered when determining temperature rating.
 - .3 All pipe sprigs or drops shall be minimum 25 millimeters (1 inch).
 - .4 Provide N.F.P.A. listed heavy duty sprinkler head guards secured by screwed clamps on:
 - .1 All sprinklers heads below 2.4 meters above finished floor.
 - .2 Other areas where heads are susceptible to damage.
- 3.8 Pipe Supports and Hangers
 - .1 Install horizontal and vertical hangers and supports in locations in accordance with N.F.P.A. 13.
- 3.9 Gauges
 - .1 Pressure gauges shall be installed to permit removal and shall be located where they will not be subject to freezing.
- 3.10 Drainage
 - .1 All sprinkler pipe shall be installed so that system can be drained.
 - .2 Provisions shall be made to properly drain all parts of the system.
 - .3 Drain pipes shall not expose any part of the system to freezing.

3.11 Fire Extinguishers (with or without cabinets)

- .1 Install fire extinguishers where indicated on drawings, as per N.F.P.A. 10 requirements, and local Fire Prevention standards. Confirm acceptance of all fire extinguisher locations with local Fire Prevention prior to installation
- .2 Allow for the supply and installation of four (4) additional fire extinguishers complete with cabinets than indicated on drawings.
- .3 Mounting height of fire extinguishers with wall brackets shall be 1500 millimeters from finished floor to top of extinguisher. Mounting height of fire extinguisher cabinets shall be 1600 millimeters from finished floor to top of cabinet.
- .4 Fire extinguishers shall be mounted in a location easily accessible by occupants and fire department as indicated on the drawings.
- .5 Provide recessed cabinets for communications devices in the Gym as noted on the drawings. Cabinets shall be sized to suit a 5 pounds fire extinguisher and left empty. Communication devices by other Division.
- .6 Confirm exact locations and mounting type with General Contractor. General Contractor to prepare wall for recessed or semi-recessed mounting where applicable.

3.12 Tags, Nameplates, and Data Plates

- .1 Mount tags and nameplates securely on components to ensure permanent installation.
- .2 Mount hydraulic data nameplates so they are clearly visible on the risers in the Sprinkler Room.

3.13 Inspections

- .1 Do not conceal any work prior to Inspection and approval by Consultant and reviewing authorities.
- .2 Provide Consultant minimum 72 hours' notice prior to inspection.
- .3 Obtain and pay for any inspection fees for review of installation.
- .4 Carry out all changes and alterations required by reviewing authorities at no extra cost to the Owner and advise Consultant of same.

3.14 Tests

- .1 Hydrostatically test sprinkler system including water supply connection and fire department connection. Provide all labour, equipment, and materials necessary to complete the test.
- .2 Tests to be done at a 350 kilopascals (50 p.s.i.) in excess of normal

working pressure but not less than 1400 kilopascals (200 p.s.i.) for a period of two (2) hours under the supervision of the authority having jurisdiction and the Consultant.

- .3 Repair any leaks and make adjustments and repeat until test is without leaks and satisfactory to the authority having jurisdiction and the Consultant.
- .4 Test and verify all valves complete with tamper switches with Division 26 to ensure all are electrically supervised.
- .5 Complete Material and Test Certificate(s) for each zone during testing. Certificates to be signed by Contractor's representative performing tests. Submit to Consultant and include in maintenance manuals.
- .6 Perform system test and balloon test for kitchen hood suppression system. Tests shall be witnessed by the Fire Prevention and the Consultant. Submit test reports and include in maintenance manuals.

3.15 Maintenance and Accessories

- .1 Mount maintenance equipment, spare parts, and cabinets in main valve station room or in a location instructed by Owner or Consultant. Confirm with Owner or Consultant prior to installation.

3.16 Sprinkler Engineer Sign-Off Letter

- .1 The sprinkler design engineer shall inspect the sprinkler installation at various stages and provide a final sign-off report confirming installation meets the design.

End of Section

1 General

1.1 General Requirements

- .1 The requirements of this section shall apply to all sections in Division 22.
- .2 Conform to Division 1 General Conditions.
- .3 All material, labour, equipment, and services required under this section shall be the full responsibility of the Plumbing Contractor including any material, labour, equipment, and services provided by their subcontractors.
- .4 Complete and submit the Supplemental Tender Form including list of equipment and materials to be used on this project and forming part of the tender documents.

1.2 Definitions

- .1 “Supply” shall mean supply only.
- .2 “Install” shall mean install and connect.
- .3 “Provide” shall mean supply, install, and connect.
- .4 “Drawings and Specifications” shall mean Contract Documents.
- .5 “Authorities” or “Authorities having jurisdiction” shall mean all agencies that enforce the applicable laws, ordinances, rules, regulations, or codes of the Place of Work.
- .6 “Work” shall mean all equipment, materials, labour, and permits to provide a complete and operational plumbing system as detailed in the drawings and specifications.
- .7 “Owner” or “C.o.P.” shall mean the City of Peterborough.

1.3 Related Work

- .1 Division 1 – General
- .2 Division 23 – HVAC
- .3 Division 26 – Electrical
- .3 Division 22 specifications form a part of the Contract Documents and shall be read, interpreted, and coordinated with all other Divisions.

1.4 Intent

- .1 The drawings and specifications are not a detailed set of installation instructions. Drawings and specifications are complementary to one another and that which is shown on one is as binding as that which is

shown on both.

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

1.5 Codes, Bylaws, Standards, and Regulations

- .1 The plumbing system shall comply with the latest editions and revisions of applicable codes, bylaws, standards, and regulations including but not limited to:
 - .1 Ontario Building Code
 - .2 A.S.H.R.A.E.
 - .3 Canadian Standards Association
 - .4 Local Building Bylaws
 - .5 Ontario Occupational Health and Safety Act
- .2 Provide work in accordance with the requirements of all applicable

government codes, local by-laws, underwriter's regulations base building standards, contract documents, and all authorities having jurisdiction.

- .3 Where discrepancies occur between contract drawings and specifications and above codes and standards referred to herein, the Contractor is to notify the Consultant in writing and obtain clarification prior to proceeding with the work.
- .4 Contractors shall not reduce the requirements on the contract drawings and specifications by applying any codes and standards referred to herein.

1.6 Permits and Fees

- .1 Apply for, obtain, and pay for all permits, fees, connections, inspections, licenses, certificates or charges necessary including all provincial and federal taxes.
- .2 Coordinate all required inspections and give necessary notice to all authorities.
- .3 Upon completion of project, provide inspection certificates confirming acceptance by all authorities having jurisdiction for all applicable disciplines.

1.7 Contract Breakdown

- .1 After the tenders close, submit a breakdown of the price into scope and trades to the satisfaction of the Consultant based on the sections of the specifications.
- .2 Breakdown shall include but not be limited to:
 - .1 Mobilization and shop drawing submission (maximum \$2,000.00)
 - .2 Underground plumbing and drainage (including storm)
 - .3 Above ground plumbing and drainage
 - .4 Plumbing Fixtures
 - .5 Plumbing Drains
 - .6 Hot Water Heater
 - .7 Pumps
 - .8 Pipe Insulation
 - .9 Video of Drainage
 - .10 Testing, Startup and Training
 - .11 Close-out Submittals – Manuals and Record Drawings (minimum

\$2,500.00)

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

1.8 Shop Drawings

- .1 Within thirty (30) days of award, the Contractor shall submit shop drawings of all equipment for the project. Partial submittals will not be accepted.
- .2 Prior to ordering of products or delivery of any products to job site, submit shop drawings electronically in P.D.F. format to the Consultant for review and comments. Submit sufficiently in advance of construction to allow ample time for review. Size of shop drawings shall be 8.5x11". 11x17" will be acceptable where appropriate for content and scale.
- .3 Submittals shall contain but not be limited to:
 - .1 Construction information
 - .2 Product data
 - .3 Performance data including performance curves
 - .4 Acoustical sound power data
 - .5 Dimensional layout and clearances
 - .6 Mounting arrangements
 - .7 Certification of compliance to applicable codes
 - .8 Operating and Maintenance information
 - .9 Wiring, single line and schematic diagrams (where applicable)
- .4 Clearly mark each sheet of printed submittal material, using arrow, underlining or circling, to show particular sizes, dimensions, wiring diagrams, operating clearances, control diagrams, project identification, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable material. Note on the submittal specified features such as special tank linings, pump seals, materials or painting.
- .5 **Prior to submission to the Consultant, the Contractor shall review all shop drawings. By this review the Contractor represents that they have determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data or will do so and that they have checked and coordinated each shop**

drawing with the requirements of the Work and of the Contract Documents.

- .6 **The Contractor's review of each shop drawing shall be indicated by their approval stamp, date and signature on the front of each page. Drawings will not be considered if not previously checked by the Plumbing Contractor.**
 - .7 Review comments from the Consultant. If shop drawings are modified, confirm changes before proceeding. If shop drawings are not approved, revise and resubmit changes for approval within two (2) weeks.
 - .8 Review of the shop drawings by the Consultant does not relieve the Contractor or their Supplier of the responsibility to provide the correct and complete equipment, material or installation.
 - .9 Keep one complete set of shop drawings at the job site during construction.
 - .10 Include stamped reviewed shop drawings in the Maintenance Manuals.
- 1.9 Product Delivery Schedule
- .1 Within two (2) weeks from shop drawing review, a schedule must be submitted by the Contractor showing projected delivery dates of all products to meet required construction schedule.
- 1.10 Construction Meetings
- .1 The Plumbing Contractor shall attend all site meetings unless otherwise pre-approved.
 - .2 Sub-trades shall attend site meetings as requested or as required.
- 1.11 Record Drawings
- .1 Refer to Section 23 05 02.
 - .2 Maintain accurate, neat, and clean record drawings on an **on-going basis** during construction to be reviewed periodically by the Consultant during construction.
 - .3 Record drawing mark-ups shall be made available at every site meeting or inspection.
 - .4 Record drawings shall include but not be limited to final location of any access doors on same for future service requirements.
 - .5 Prior to Substantial Performance submit a complete set of record drawings in P.D.F. format.
- 1.12 Reports

- .1 Provide the following reports upon completion of work by certified Contractors for review and approval by the Consultant:
 - .1 Equipment Start-Up Reports
 - .2 Piping Pressure Test Reports
 - .3 V.F.D. Startup Report
 - .4 Backflow Preventer Test Report
 - .5 Other equipment startup reports and test sheets certified by the manufacturer or a qualified technician
 - .6 Demonstration and Training Reports/Logs
 - .2 All reports shall be dated and signed by the Technician who performed the start-up and/or tests.
- 1.13 Maintenance Manuals
- .1 Refer to Section 23 05 02.
 - .2 Provide the Owner with two (2) **indexed**, hard cover maintenance manuals plus one (1) electronic copy on memory stick. Manuals shall contain and be tabbed in the following order:
 - .1 Table of Contents
 - .2 Contractor's, Manufacturer's and Supplier's Contact Information
 - .3 Warranty Letter
 - .4 Valve schedule
 - .5 Colour coding charts for access areas
 - .6 Reports as specified herein and as applicable
 - .7 ALL stamped approved shop drawings – Include a tab and blank section for any Owner supplied equipment
 - .8 Equipment maintenance instructions and manuals
 - .9 Record drawings
 - .3 Submit one (1) complete copy to the Consultant for review and approval. Revise based on any comments and resubmit all copies and electronic copy to Consultant.
- 1.14 Testing and Startup
- .1 Refer to Section 22 05 92.

- .2 Test and startup all equipment and work.
- .3 Fully coordinate all testing and startups with all trades, the Consultant, and authorities having jurisdiction.
- .3 **The Controls Contractor shall be present during all equipment start-ups. Coordinate scheduling with Controls Contractor.**
- .4 Provide adequate notice to all parties.

1.15 Demonstration and Training

- .1 Demonstrate and train the Owner on proper operation of the system.
- .2 The Contractor shall arrange for all necessary personnel and equipment specialists to be in attendance for purposes of demonstration and training.
- .3 Provide instruction by a manufacturer's representatives as required too fully demonstrate the systems.
- .4 Demonstration and Training shall include but not be limited to:
 - .1 Training in the normal, abnormal and emergency operation of all systems provided under this Division.
 - .2 Review of all necessary maintenance procedures, including winterization, of all systems provided under this Division.
 - .3 Provision of a documented maintenance program covering all systems provided or modified under this contract.
 - .4 Review of all close-out documentation including complete maintenance manuals and record drawings.
- .5 Prepare a Training Agenda and Log for signature by all Participants. Submit to Consultant and include in Manuals.

1.16 Substantial Completion and Performance

- .1 Substantial completion and performance shall be determined and awarded by the Consultant.
- .2 Complete the following to the satisfaction of the Consultant prior to request for substantial performance:
 - .1 Fire Stopping
 - .2 System Testing and Startups including report
 - .3 Maintenance Manuals
 - .4 Record Drawings
 - .5 Demonstration and Training

1.17 Warranty

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

2 Products

2.1 Materials

- .1 All material used shall be new, free from defects, of quality specified, and installed in accordance with manufacturer's instructions.
- .2 Major equipment shall have nameplates on the exterior of the equipment in a visible location containing manufacturer's name, model number, serial number, performance data, and electrical characteristics.
- .3 The same manufacturer shall be used for types of equipment used in similar applications.
- .4 It is the responsibility of the Contractor to store and protect materials supplied by this scope.
- .5 Materials shall be stored in original containers.
- .6 Submit to the Consultant and the Owner, current M.S.D.S. Sheets for any products being used on the job site where they exist.
- .7 Remove and dispose of all redundant materials and garbage from site.
- .8 Supply anchor bolts and templates for installation by other Divisions.

2.2 Selected Products and Equivalentents

- .1 Sections within Division 22 list "Acceptable Manufacturers" which must meet characteristics of the specified equipment and products for each section.
- .2 Base specified products are specified and/or shown on the drawings, and identified by manufacturer's name, type and catalogue number.
- .3 Any alternate manufacturers from base specified products and equipment must equal or exceed the quality, finish and performance of those base specified and/or shown, and not exceed the space requirements allotted on the drawings. Include costs for any associated work to accommodate such substitutions, including the Consultant's time and revisions to the work of other divisions (i.e. electrical changes).
- .4 If item or material specified is unobtainable, state in Tender proposed

substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after the Contract has been awarded.

- .5 If item of size indicated is unobtainable, supply next larger size without additional charge.

2.3 Quality of Product

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

2.4 Product Finishes

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

2.5 Motors

- .1 Provide high efficiency motors for plumbing equipment as specified.
- .2 If delivery of specified motor will delay delivery or installation of any equipment, install a motor approved by Consultant for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- .3 Motors under 373 watts, (1/2 horsepower): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, voltage as indicated.
- .4 Motors 373 watts, (1/2 horsepower) and larger: E.E.M.A.C. Class B., squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees Celsius (72 degrees Fahrenheit), 3 phase, voltage as indicated.

2.6 Belt Drives

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
- .3 For motors under 7.5 kilowatts (10 horsepower): standard adjustable pitch drive sheaves, having plus or minus 10 percent range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kilowatts (10 horsepower and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .6 Motor slide rail adjustment plates to allow for centre line adjustment.
- .7 Provide sheave changes as required for final balancing.

2.7 Guards

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives:
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 millimeter (18 gauge) thick sheet metal tops and bottoms.
 - .3 40 millimeter (1-1/2 inch) diameter holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 106 millimeter (16 gauge) thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 20 millimeter (3/4 inch) mesh.

- .2 Net free area of guard: not less than 80 percent of fan openings.
- .3 Securely fasten in place.
- .4 Removable for servicing.

2.8 Equipment Supports

- .1 Refer to Section 22 05 29.
- .2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of – Structural Steel Section. Submit structural calculations with shop drawings.
- .3 Install base mounted equipment on chamfered edge housekeeping pads, minimum of 100 millimeters (4 inches) high and 150 millimeters (6 inches) larger than equipment dimensions all around.

2.9 Sleeves

- .1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated.
- .2 Schedule 40 steel pipe.
- .3 Sleeves with annular fin continuously welded at midpoint:
 - .1 Through foundation walls.
 - .2 Where sleeve extends above finished floor.
 - .3 Through fire rated walls and floors.
- .4 Sizes: minimum 6 millimeter (1/4 inch) clearance all around, between sleeve and un-insulated pipe or between sleeve and insulation.
- .5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25 millimeters (1 inch) above other floors.
- .6 Fill voids around pipes:
 - .1 Caulk between sleeve and pipe in walls and floors with water proof fire retardant non-hardening mastic.
 - .2 Where sleeves pass through walls or floors, provide space for firestopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.
 - .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
 - .4 Fill future-use sleeves with lime plaster or other easily removable filler.
 - .5 Coat exposed exterior surfaces of ferrous sleeves with heavy

application of zinc rich paint to C.G.S.B. 1-GP-181M+Amdt-Mar-78.

- .6 Where pipes pass through below grade walls and floors, seal space with a 2-part, 98 percent closed-cell urethane foam sealant, with 145-lb compressive strength (A.S.T.M. D1621). Sealant shall be capable of holding 22 feet (6.7 meters) water head pressure continuous or 90 feet (27 meters) water head pressure short-term. It shall block up to 5 p.s.i. (0.3 bar) gas or vapor continuous. Equal to Polywater F.S.T.
- .7 Provide minimum 20 gauge duct sleeves where ducts pass through masonry concrete or fire rated assemblies. Maintain minimum 25 millimeter clearance all around or to the requirements of the authority having jurisdiction. Seal at all as indicated.

2.10 Fire Stopping

- .1 This Contractor shall work with all other Contractors on the project in providing one common method of fire stopping all penetrations made in the fire rated assemblies.
- .2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.
- .3 Do not use cementious or rigid seals around penetrations for pipe, ductwork, or other plumbing items.
- .4 Insulated pipes and ducts; ensure integrity of insulation and vapour barrier at fire separation.
- .5 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.
- .6 Comply with the requirements of C.A.N. 4-S115-M35, and do not exceed opening sized for which they have been tested.
- .7 Systems to have an F. or F.T. rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide "fire wrap" blanket around services penetrating fire walls. Extent of blanket must correspond to ULC recommendations.
- .8 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.
- .9 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.
- .10 Fire stop materials are to be capable of receiving finish materials in those

areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.

- .11 Firestopping shall be inspected and approved by local authority prior to concealment of enclosure.
 - .12 Install material and components in accordance with U.L.C. certification, manufacturer's instructions and local authority.
 - .13 Submit product literature and insulation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and Consultant.
 - .14 Manufacturer of product shall provide certification of installation. Submit letter to the consultant.
 - .15 Acceptable Manufacturers:
 - .1 Fryesleeve Industries Inc.
 - .2 General Electric Pensiil Firestop Systems
 - .3 International Protective Coatings Corporation
 - .4 Rectorseal Corporation (Metacaulk)
 - .5 Proset Systems
 - .6 3M
 - .7 A.D. Systems
 - .8 Hilti
 - .16 Ensure firestop manufacturer representative performs on-site inspections and certifies installation. Submit inspection reports/certification at time of substantial completion.
- 2.11 Escutcheons
- .1 On pipes and ductwork passing through walls, partitions, floors and ceilings in finished areas.
 - .2 Chrome or nickel plated brass or Type 302 stainless steel, one piece type with set screws.
 - .3 Outside diameter to cover opening or sleeve.
 - .4 Inside diameter to fit around finished pipe.
- 2.12 Spare Parts
- .1 Provide spare parts as specified under this Division.

- .2 Provide list of equipment in maintenance manuals indicating corresponding spare parts required. List of spare parts to be signed off by receiving personnel.

2.13 Special Tools

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

3 Execution

3.1 Site Examination

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

3.2 Interference and Coordination Drawings

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

3.3 Separation of Services

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

3.4 Workplace Safety

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

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

3.5 Temporary Requirements

- .1 All temporary requirements to complete plumbing work during construction shall be the responsibility of the Plumbing Contractor except temporary power or water.

3.6 Location of Equipment

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

3.7 Mounting Heights

- .1 Mounting height of equipment is from finished floor to equipment unless otherwise specified or indicated. Coordinate with block coursing if applicable.
- .2 Where mounting heights are not indicated on the drawings, obtain verification from the Consultant before proceeding.
- .3 Install plumbing equipment at the following heights unless otherwise indicated on the architectural drawings. Confirm all heights prior to installation. Where confirmation or coordination has not been done and changes are required, the Contractor shall cover all costs.

3.8 Excavating and Backfilling

- .1 Provide all excavating and backfilling inside and to 1.5 meters outside the building for plumbing pipes, drains and equipment. All backfilling shall be new clean granular 'A' fill brought in specifically for the purpose of backfilling to the underside of floor slab. All backfilling shall be compacted

at intervals not more than 150 millimeters (6 inches) layer to the satisfaction of the Consultant.

- .2 Provide excavating and backfilling outside the building with granular 'A' brought in specifically for backfilling to a minimum of 450 millimeters (18 inches) over the pipe. Backfilling outside building over and above the 450 millimeters (18 inches) backfill as previously specified herein shall be by the Plumbing Contractor as specified under Division 2. Where backfilling outside the building is not specified under Division 2, the Plumbing Contractor shall provide new clean granular 'A' fill to grade level.
- .3 Bottoms of trenches shall be excavated so that the pipe will be supported on a 150 millimeters (6 inches) compacted bed of clean granular 'A' fill. Provide all necessary pumping to maintain excavation free of water.
- .4 Should water be encountered during excavation, the Plumbing Contractor shall provide all labour and material, including all equipment required for dewatering the excavation. After the water has been removed, this Contractor shall install a 300 millimeter (12 inch) base of compacted 50 millimeter (2 inch) clear stone covered with filter cloth before installing backfill as detailed and/or as specified.
- .5 Be responsible for all weather protection required to install piping and/or equipment to the satisfaction of the Consultant.
- .6 Be responsible for providing all clear stone or granular 'A' material suitable for application to replace existing soil not suitable for backfilling above the 450 millimeter (18 inch) bedding material.
- .7 It is the responsibility of the Contractor to review the soils report. Additional work requested due to failure of soil conditions due to Contractor not reviewing report will not be entertained.

3.9 Repairs, Cutting and Restoration

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

ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

3.10 Painting

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

3.11 Concealment

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

3.12 Access Doors

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

3.13 Clearances and Accessibility

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

3.14 Equipment and System Protection

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

3.15 Supports

- .1 Provide all miscellaneous metals and materials as required for support, hanging, anchoring, and guiding of all equipment, ductwork, piping, and all other work in Division 22.
- .2 All supports must be securely mounted to structures.
- .3 Refer to Section 22 05 29.

3.16 Fire Stopping

- .1 Refer to Part 2 herein.

3.17 Cleaning

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

3.18 Owner Supplied Equipment

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

3.19 Video Recording of New Underground Services

- .1 Prior to final acceptance of the new underground plumbing system and prior to pouring the floor, this Contractor shall retain a qualified Contractor to video tape the new sanitary and storm drainage piping and branch piping. Transfer all video tape information to U.S.B. key.
- .2 This Contractor shall flush the new storm and sanitary system to remove all debris prior to final videotaping of systems.
- .3 Provide three (3) copies of U.S.B. Key.
- .4 Identify video routing on As Built drawings.

3.20 Identification and Labeling

- .1 All equipment, valves, panels and devices shall be labeled under this Division.
- .2 Refer to Section 22 05 53.

3.21 T.S.S.A. Inspection

- .1 Prior to final completion of the project, this Contractor shall make application, arrange, and pay for a T.S.S.A. Inspection of all piping systems and equipment installations, including, but not limited to refrigeration, fuel piping, heating plant, and associated equipment installed under the contract.
- .2 Provide a copy of the TS.S.A. Reports in the maintenance manuals for each system.

3.22 Field Review and Deficiencies

- .1 The Contractor shall notify the Consultant when the job is ready for field review at various stages including rough-in stages.
- .2 During the course of construction, the Consultants will monitor construction and provide written reports of work progress, discussions and deficiencies.
- .3 The Contractor shall correct all deficiencies within the work period prior to the next review.
- .4 The Contractor shall not conceal any work until inspected. Where work was concealed, the Contractor shall remove and replace tiles, coverings or other obstructions to allow proper inspection at the Contractor's expense.
- .5 Upon completion of the project the Consultant will do a final review. Upon receiving the final inspection report, the Contractor must correct and sign back the inspection report indicated all deficiencies are completed. A re-inspection will only be done once the Consultant receives this in writing. Where the Consultant performs the re-inspection and the work is not complete, the Contractor is responsible for reimbursing the Consultant for the field review. The fee for additional reviews will be at the Consultant's hourly rates plus mileage and applicable taxes to be paid directly to the Consultant prior to performing the next field review.

End of Section

- 1 General
 - 1.1 Manufacturer
 - .1 Provide valves of same manufacturer throughout where possible.
 - .2 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.
 - 1.2 Quality Assurance
 - .1 All valves shall meet all M.S.S., A.N.S.I. and A.S.M.E. manufacturing standards.
 - 1.3 Submittals
 - .1 Manufacturer's data and shop drawings for all valves and accessories including dimensions, pressure ratings, materials, service acceptability.
- 2 Products
 - 2.1 General
 - .1 Provide valves of same manufacturer throughout where possible.
 - .2 All valves shall be acceptable for domestic water use, certified lead free.
 - .3 Metallic valves shall be suitable for solder or threaded connections. Provide solder to threaded adapters where applicable.
 - 2.2 Check Valves
 - .1 2 inches (50 millimeters) and smaller: Class 125/200 P.S.I., lead free bronze body and cap, bronze seat, solder or threaded ends. Equal to Kitz #822 and #823
 - .2 2.5 inches (63 millimeters) and larger: To Class 150, stainless steel body, hard face seat, 13 percent chrome, flanged ends. Equal to Kitz #150UOAM.
 - 2.3 Ball Valves (Brass)
 - .1 600 W.O.G., lead free brass, two or three piece body, chrome plate ball, full port, teflon seats, blow-out proof stem, threaded or soldered ends, lever handle. Soldered up to 3 inches, threaded up to 4 inches.
 - .2 Acceptable Manufacturers:
 - .1 Jenkins
 - .2 NH
 - .3 Kitz #858 & #859

.4 Red & White (Toyo) 5044A-LF and 5049-LF

.5 MAS #B3-LF and #B4-LF

2.4 Circuit Balancing Valves (C.B.V.) – Domestic Water

- .1 Provide circuit balancing valve on each domestic recirculation loop designed specifically for use in drinking water applications, N.S.F./A.N.S.I. 61-G rated for commercial hot water service (temperature rated to 180 degrees Fahrenheit/82 degrees Celsius) and certified by the N.S.F. with all wetted parts stainless steel.
- .2 Lead free construction in compliance with A.N.S./N.S.F.-372.
- .3 Series 300 stainless steel body, nickel plated brass union nut, and tamper-resistant 300 series stainless steel flow cartridge.
- .4 Valve shall be suitable for minimum flow of 0.3 g.p.m. and maximum flow of 12.0 g.p.m., and flow rate pre-set accuracy variation of plus/minus 5 percent over 95 percent of the control range.
- .5 Valves shall have a full body rating of 400 p.s.i., but is suitable for working pressures with differential control ranges of 2 to 32 p.s.i. or 5 to 60 p.s.i. differential.
- .6 All wetted parts shall comply with N.S.F./A.N.S.I. Standard 372 for minimal lead content.
- .7 Compact inline design for tight installations.
- .8 Acceptable Manufacturer
 - .1 I.M.I. T.A. B.B.V. L.F. or 76X Series, Victaulic I.C.S.S.

2.5 Pressure Reducing Valves – Water

- .1 Listed to A.S.S.E. 1003 and I.A.P.M.O. and certified to C.S.A. B356.

2.6 Vacuum Breakers – Water

- .1 Bronze body, brass trim, composition silicone float disc, full size orifice.

2.7 Relief Valves

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

2.8 Drain Valves

- .1 Bronze compression stop with $\frac{3}{4}$ inch hose threaded.
- .2 Brass ball valve with $\frac{3}{4}$ inch hose thread.
- .3 Provide hose thread connection on valve or piping.

- .4 Equal to #868C (Lead Free), KITZ #68AC (Non Lead Free)
- 2.9 Double Check Valve Assembly - Reduced Pressure Type
- .1 Bronze or red brass body, stainless steel springs, composition diaphragm.
 - .2 Independent acting spring loaded double internal disc valve, three chamber, discharge to atmosphere.
 - .3 Acceptable Models:
 - .1 Watts 009 QT
 - .2 Zurn 975 XL
 - .3 Febco 825 Y
 - .4 Combraco 40-200
 - .4 Non-electronic testing apparatus including gauge, hoses, fittings, accessories, and case. Maximum temperature 104.4 degrees Celsius (220 degrees Fahrenheit), maximum pressure 1034 kilopascal (150 p.s.i.). Equal to Watts TK-9A.
- 2.10 Strainers
- .1 Strainers 50 millimeters (2 inches) and smaller shall be constructed for 250 p.s.i.g. operating pressure at 406 degrees Fahrenheit and shall have a cast iron threaded body and 20 mesh Type 304 stainless steel screen.
 - .2 Strainers larger than 50 millimeters (2 inches) shall be constructed for 125 p.s.i.g. at 150 degrees Fahrenheit and shall have a cast iron flanged body and a 3/64 inch perforated Type 304 stainless steel screen up to 75 millimeters (3 inches) and a 1/8 inch perforated Type 304 stainless steel screen on 100 millimeters (4 inches) and larger.
 - .3 Screen free area shall be minimum three times area of inlet pipe. Provide valved drain and hose connection off strainer bottom.
 - .4 Strainers 50 millimeters (2 inches) and smaller shall have straight thread and gasketed caps and plugged blow-off connections.
 - .5 Strainers larger than 50 millimeters (2 inches) shall include drain connections complete with ball valve, cap and chain.
 - .6 Grooved end (where approved): 50 millimeters (2 inches) and larger, 300 P.S.I. (2065 kilopascal) Y-Type Strainer shall consist of ductile iron body, A.S.T.M. A-536, Grade 65-45-12, Type 304 stainless steel perforated metal removable baskets with 1/16 inch (1,6 millimeters) diameter perforations 2 inches to 3 inches (DN50-DN75) strainer sizes, 1/8 inch (3,2 millimeters) diameter perforations 4 inches to 12 inches (DN100-

DN300) strainer sizes, and 0.156 inch (4 millimeters) diameter perforations for larger sizes. Victaulic Style 732 and W732.

2.11 Pressure Ratings

- .1 Unless otherwise indicated, use valves suitable for minimum 860 kilopascal (125 p.s.i.) and 232 degrees Celsius (450 degrees Fahrenheit).

3 Execution

3.1 General

- .1 All valves shall be located such that the removal of their bonnets is possible.
- .2 Install valves with stems upright or horizontal, not inverted.
- .3 All valves shall be installed to allow for ease of access, service and reading of devices from the floor.

3.2 Application

- .1 Use ball valves on pressure gauges.
- .2 Use plug cocks, globe valves, ball valves, butterfly valves, and metering valves in water systems for throttling service.

3.3 Isolation Valves

- .1 Isolation valves are to be ball type valves, pipe size as required, but in no case less than 13 millimeters ($\frac{1}{2}$ inch) diameter.
- .2 For equipment removal purposes. Install valves as close as possible to isolated equipment in order to minimize the amount of water lost during maintenance, replacement or drain down operations.
- .3 Isolation drain valves are to be provided with combination air inlet fitting as required to relieve vacuum during draining operations.
- .4 Install ball valves where approved for shutoff and isolating service, or to isolate equipment, parts of systems or vertical risers.
- .5 Provide drain valves at main shutoff valves, low points of piping and equipment.

3.4 Circuit Balancing Valves (C.B.V.) – Domestic Water

- .1 The Contractor shall install a C.B.V. on each recirculating loop.
- .2 Install CBVs in accordance with manufacturer's instructions including straight pipe run upstream and downstream of C.B.V.

- .3 Valves shall be installed with flow in the direction of the arrow on the valve body.
 - .4 Label ceiling tile or gypsum board ceilings where C.B.V. is installed above ceiling. Provide access door for access where required.
- 3.5 Pressure Reducing Valves
- .1 Provide pressure reducing valves where shown or where required. Provide adequately rated shutoff valves.
 - .2 Install as per manufacturer's recommendations.
 - .3 Install in vertical position only.
- 3.6 Relief Valves
- .1 Provide relief valves at pressure tanks, low pressure side of reducing valves, heating convertors, expansion tanks and where indicated.
 - .2 Pipe relief valve to nearest floor drain.
 - .3 System relief valve capacity shall equal make up pressure reducing valve capacity. Equipment relief valve capacity shall exceed input rating of connected equipment.
 - .4 Where one line vents several relief valves, cross sectional area shall equal sum of individual vent areas.
- 3.7 Drain Valves
- .1 Provide ball valves for drains on open systems.
 - .2 Provide unions downstream of the valve to allow breaking the piping system.
 - .3 Provide hose thread connection on drain valve and piping.
- 3.8 Double Check Valve Assembly
- .1 Install reduced pressure double check valve assembly to isolate domestic system where indicated on drawings and as required by code.
 - .2 Install double check valve assembly at no more than 1.5 meters (5 feet) above finished floor and to allow a minimum of 1 meter (3 feet) clearance above the device for connection and operation of testing equipment.
 - .3 Pipe overflow to drain with air gap.
 - .4 Provide shutoff valves and unions on both sides of double check valve assembly for testing purposes.

3.9 Strainers

- .1 Install on the inlet of any large pumps and where otherwise indicated.

End of Section

- 1 General
 - 1.1 Quality Assurance
 - .1 Domestic water pipe supports shall meet the requirements of Ontario Building Code.
 - 1.2 General Requirements
 - .1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade and provide for expansion and contraction.
 - .2 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.
 - .3 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
 - .4 Obtain approval prior to drilling for inserts and supports for piping systems.
 - .5 Obtain approval prior to using percussion type fastenings.
 - .6 Use of other piping or equipment for hangers and supports is not permitted.
 - .7 Use of perforated band iron, wire or chain as hangers is not permitted.
 - 1.3 Firestop Sealants and Collars
 - .1 Standard method of fire tests of firestop system C.A.N. 4-S115-M85.
 - .2 U.L. Classified and/or F.M. Systems Approved and tested to the requirements of A.S.T.M. E814 (U.L.1479).
 - .3 Seals, assemblies and materials for penetration of fire rated surfaces shall be listed by F.M. and certified by U.L. or U.L.C. for the service application.
 - 1.4 Submittals
 - .1 Firestop materials: Submit service limitations, installation instructions, U.L. certification and F.M. listing.
 - .2 Fire rated penetration seals: Submit dimensional data, service limitations, installation instructions, U.L. certification and F.M. listing.
- 2 Products
 - 2.1 Inserts

- .1 Inserts shall be malleable iron case or galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods and lugs for attaching to forms.
 - .2 Size inserts to suit threaded hanger rods.
- 2.2 Suspended Mechanical Equipment:
- .1 Suspend mechanical equipment from structure with adjustable length steel rods, threaded both ends or continuous threaded, complete with lock nuts on both ends. Provide spreader beams to distribute weight.
 - .2 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
 - .3 Provide anchors, bolts and accessories required for mounting and anchoring equipment.
- 2.3 Pipe Hangers and Supports
- .1 Pipe hangers shall wrap around outside of insulation for all sizes. Piping shall be provided with insulation flashing of heavy gauge metal to prevent crushing and hanger sized for exterior of insulation.
 - .2 Hangers:
 - .1 Pipe Sizes 13 millimeter (½ inch) to 38 millimeters (1-½ inches): Adjustable wrought steel ring, or plated strap.
 - .2 Pipe Sizes 50 millimeters (2 inches) and over: Adjustable wrought steel clevis.
 - .3 Hanger Rods: Provide steel hanger rods, threaded both ends or continuous threaded, complete with lock nuts on both ends.
 - .4 Saddles shall wrap around the outside of the insulation for all piping and be sized accordingly.
 - .3 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods, cast iron roll and stand for hot pipe sizes 150 millimeters (6 inches) and over.
 - .4 Wall Support:
 - .1 Pipe Sizes to 75 millimeters (3 inches): Cast iron hook, or fabricated bracket of 1 inch by 1 inch by ¼ inch angle bar.
 - .2 Pipe Sizes 100 millimeters (4 inches) and over: Welded steel bracket and wrought steel clamp.
 - .5 Vertical Support:
 - .1 Steel riser clamp.

- .6 Floor Support:
 - .1 Fabricated stand and pipe clamp or saddle.
- 2.5 Equipment Bases and Curbs
 - .1 Equipment bases and curbs shall be provided by the General Contractor. The Mechanical Contractor shall coordinate locations and sizes with the General Contractor.
 - .2 Provide mounting plates to be formed into pads.
- 3 Execution
 - 3.1 Inserts
 - .1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
 - .2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 100 millimeters (4 inches) or ducts over 1500 millimeters (60 inches) wide.
 - .3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
 - .4 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.
 - .5 Expansion bolt type connections will be approved under certain conditions. Obtain approval from the Consultant. Generally, pipe 50 millimeters (2 inches) or smaller, and ducts less than 600 millimeters by 300 millimeters (24 inches by 12 inches) will be approved, subject to adequate number of support points.
 - 3.2 Suspended Mechanical Equipment:
 - .1 Suspend mechanical equipment from structure with adjustable length steel rods. Provide spreader beams to distribute weight.
 - .2 The threaded rod shall be secured to trusses or to steel angle bars spanning the building trusses. The steel spanning bars are to be provided by this Division.
 - .3 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
 - .4 Provide anchor bolts and accessories required for mounting and anchoring equipment.
 - .5 Provide rigid anchors for ducts and pipes immediately after vibration connections to equipment.

3.3 Pipe Hangers and Support

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

<u>Nominal Pipe Size</u>	<u>Distance Between Supports</u>	<u>Hanger Rod Diameter</u>
13 millimeters (½ inch)	1.8 meters (6 feet)	9.5 millimeters (3/8 inch)
19 to 38 millimeters (¾ inch to 1-½ inches)	2.4 meter (8 feet)	9.5 millimeters (3/8 inch)
50 to 63 millimeters (2 inch to 2-½ inches)	3.0 meter (10 feet)	9.5 millimeters (3/8 inch)
63 to 100 millimeters (3 inches to 4 inches)	3.6 meters (12 feet)	13 millimeters (½ inch)
150 to 300 millimeters (6 inches to 12 inches)	4.3 meters (14 feet)	13 millimeters (½ inch)
350 to 450 millimeters (14 inches to 18 inches)	5.0 meters (16 feet)	25 millimeters (1 inch)

- .3 Install hangers to provide minimum 32 millimeters (1-¼ inches) clear space between finished covering and adjacent work.
- .4 Place a hanger within 300 millimeters (12 inches) of each horizontal elbow.
- .5 Use hangers which are vertically adjustable 38 millimeters (1-½ inches) minimum after piping is erected.
- .6 Support vertical piping at every floor.
- .7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .8 Where practical, support riser piping independently of connected horizontal piping.
- .9 Exposed piping, with less than 2.6m (8½ ft) clearance to floors shall be provided with two times the number of hangers normally required. Spacing shall be equal or adjusted for maximum benefit.
- .10 Provide copper plated hangers and supports for copper piping or provide nonferrous packing between hanger or support and piping.
- .11 Large capacity piping with vibration potential shall not be suspended from any building structure that will allow transfer of vibrations to the occupied spaces.

3.4 Equipment Bases and Curbs

- .1 All equipment shall be mounted on concrete bases, minimum 100 millimeters (4 inches) high.
- .2 A curb shall be provided around all piping passing through mechanical room floors, minimum 100 millimeters (4 inches) high.
- .3 Equipment bases and curbs shall be provided by the General Contractor. The Mechanical Contractor shall coordinate locations and sizes with the General Contractor.
- .4 Provide mounting plates to be formed into pads.

End of Section

1 General

1.1 References

- .1 Canadian General Standards Board (C.G.S.B.)
 - .1 C.A.N./C.G.S.B.-1.60-M89, Interior Alkyd Gloss Enamel.
 - .2 C.A.N./C.G.S.B.-24.3-92, Identification of Piping Systems.

1.2 Product Data

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

1.3 Product Literature

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

2 Products

2.1 Manufacturer's Equipment Nameplates

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

2.2 System Nameplates

- .1 Colours:
 - .1 Hazardous: red letters, white background
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 millimeter (1/8 inch) thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to the following table:

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

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

.4 Locations:

.1 Equipment in Mechanical Rooms: Use size #9.

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

2.3 Identification of Piping Systems

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To C.A.N./C.G.S.B. 24.3 except where specified otherwise.

.2 Legend:

.1 Block capitals to sizes and colours listed in C.A.N./C.G.S.B.-24.3.

.3 Arrows showing direction of flow:

.1 Outside diameter of pipe insulation less than 75 millimeters (3 inches): 100 millimeters (4 inches) long x 50 millimeters (2 inches) high.

.2 Outside diameter of pipe or insulation 75 millimeters (3 inches) and greater: 150 millimeters (6 inches) long x 50 millimeters (2 inches) high.

- .3 Use double-headed arrows where flow is reversible.
 - .4 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
 - .5 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 millimeters (3/4 inch) and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 All other pipes: Pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating suitable for ambient of 100 percent R.H. and continuous operating temperature of 150 degrees Celsius (300 degrees Fahrenheit) and intermittent temperature of 200 degrees Celsius (395 degrees Fahrenheit).
 - .6 Colours and Legends:
 - .1 Where not listed, obtain direction from Consultant.
 - .2 Colours for legends, arrows:

<u>Background colour</u>	<u>Legend</u>	<u>Arrows</u>
Yellow	White	Black
Green	White	Black
Red	White	Black
- 2.4 Concrete Pads for Mechanical Equipment
- .1 General Contractor to paint tops and sides of all concrete pads for mechanical equipment with two (2) coats of yellow paint.
- 2.5 Valves, Controllers
- .1 Brass tags with 15 millimeters (1/2 inches) stamped identification data filled with black paint.
 - .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.
 - .3 Provide coloured adhesive label indication on ceiling grid to locate valves/equipment above. Label description to match device. Size, colour and description to be pre-approved by Consultant.
- 2.6 Language

- .1 Identification to be in English.
- 3 Execution
 - 3.1 Timing
 - .1 Provide identification only after all painting specified has been completed.
 - 3.2 Installation
 - .1 Perform work in accordance with C.A.N./C.G.S.B.-24.3 except as specified otherwise.
 - .2 Provide U.L.C. and/or C.S.A. registration plates as required by respective agency.
 - 3.3 Nameplates
 - .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
 - .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
 - .3 Protection:
 - .1 Do not paint, insulate or cover in any way.
 - 3.4 Location of Identification on Piping Systems
 - .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels not more than 1.7 meters (5 foot 8 inches) intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
 - .2 Adjacent to each change in direction.
 - .3 At least once in each small room through which piping passes.
 - .4 On both sides of visual obstruction or where run is difficult to follow.
 - .5 On both sides of separations such as walls, floors, partitions.
 - .6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.
 - .7 At beginning and end points of each run and at each piece of equipment in run.
 - .8 Identification to be easily and accurately readable from usual operating areas and from access points. Position of identification to be

approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 Valves

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

End of Section

1 General

1.1 Quality Assurance

- .1 Test equipment and material where specified required by authorities having jurisdiction to demonstrate its proper and safe operation.
- .2 Test procedures shall be in accordance with applicable portions of:
 - .1 Ontario Building Code
 - .2 American Society of Heating, Refrigeration and Air Conditioning Engineers (A.S.H.R.A.E.)
 - .3 American Society of Mechanical Engineers
 - .4 Ontario Ministry of Health
 - .5 Local codes and ordinances
 - .6 Other recognized test codes
- .3 Provide additional tests and re-testing as required and requested by the Consultant or Owner.

1.2 Submittals

- .1 Obtain certificates of approval and acceptance from authorities having jurisdiction and include in Operating and Maintenance Manuals.
- .2 On completion of mechanical installation, provide certification of tests with detailed data as required. Itemize tests as to time performed and personnel responsible. Include a copy of field data in Operating and Maintenance Manuals.

1.3 Liability

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

2 Products

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

3 Execution

3.1 Pressure Tests

- .1 Piping, fixtures or equipment shall not be concealed or covered until inspected and approved by the Consultant.

- .2 Provide equipment, materials and labour for tests. Use test instruments from approved laboratory or manufacturer and furnish certificate showing degree of accuracy.
- .3 Test equipment and material where specified required by authorities having jurisdiction to demonstrate its proper and safe operation.
- .4 Provide four (4) days notice to the Consultant before tests.
- .5 Carry out hydraulic tests for eight (8) hours and maintain pressure. Where leakage occurs, repair and retest.
- .6 Domestic and Make-Up Water Piping: Test to 1½ times maximum working pressure or 1034 kilopascal (150 p.s.i.) water pressure measured at system low point.
- .7 Drainage Systems: Test by filling with water to produce water pressure of 35 kilopascal (5 p.s.i.) minimum and 83 kilopascal (12 p.s.i.) maximum. Check for proper grade and obstruction by ball test or other approved means.

3.2 Equipment Tests

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

3.3 Test Reports

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

End of Section

- 1 General
 - 1.1 Work Included
 - .1 Piping Insulation
 - .2 Adhesives, Tie wires, Tapes
 - .3 Recovering
 - 1.2 Quality Assurance
 - .1 All workers engaged in the application of insulation shall be journeymen, or indentured apprentices working under a journeyman who is on the site. Trades Qualification certificates must be submitted prior to commencing work and must be on site for inspection.
 - 1.3 Job Conditions
 - .1 Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness.
 - .2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.
 - 1.4 Acceptable Manufacturers:
 - .1 Fibreglass Canada
 - .2 Knauf
 - .3 Mason
 - .4 Pittsburg Corning
- 2 Products
 - 2.1 General
 - .1 Adhesives, Insulation, Coatings, Sealers and Recovering Jackets shall have composite fire and smoke hazard ratings not exceeding 25 for flame spread and 50 for smoke developed.
 - .2 Adhesives, coatings and sealers shall be waterproof.
 - 2.2 Materials
 - .1 Insulation shall be precovered, preformed insulation complete with foil or kraft all purpose jacket unless otherwise noted.
 - .2 Insulation shall be 1 inch thick unless otherwise noted.

- .3 Cold Piping: Fine fibrous glass insulation with factory applied vapour barrier jacket, molded to conform to piping, "K" value at 0.24 b.t.u./inch/square foot/degrees Fahrenheit/hour.
 - .4 Hot and Tempered Water Piping: Fine fibrous glass insulation with factory applied general purpose jacket, molded to conform to ping, "K" value at 0.24 b.t.u./inch/square foot/degrees Fahrenheit/hour. 1+
 - .5 Concealed Vents: Flexible fibrous glass insulation with factory applied vapour barrier jacket, molded to conform to piping, "K" value at 0.26 b.t.u./inch/square foot/degrees Fahrenheit/hour.
 - .6 Condensate Piping: Fine fibrous glass insulation with factory applied vapour barrier jacket, molded to conform to piping, "K" value at 0.24 b.t.u./inch/square foot/degrees Fahrenheit/hour.
 - .7 Roof Drainage: Flexible fibrous glass insulation, "K" value at 0.26 b.t.u./inch/square foot/degrees Fahrenheit/hour.
 - .8 Recovering Jackets, Exposed Finished Areas (i.e. Mechanical Rooms, Custodial Rooms, Storage Rooms, etcetera): P.V.C. pre-formed.
- 3 Execution
- 3.1 Preparation
- .1 Do not install covering before piping and equipment has been tested and approved.
 - .2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.
- 3.2 Installation
- .1 In non fire rated surfaces, ensure insulation is continuous through inside walls. Pack around pipes with fireproof self-supporting insulation material, properly sealed.
 - .2 Finish insulation neatly at hangers, supports and other protrusions.
 - .3 Provide recovering jackets on exposed insulation as specified herein.
 - .4 Coat recovering jacket with two coats of waterproof fire retardant coating.
 - .5 Do not install and seal vapour proof insulation if ambient air has a high humidity.
 - .6 Pipe hangers shall wrap around outside of insulation for all sizes. Piping shall be provided with insulation flashing of heavy gauge metal to prevent crushing and hanger sized for exterior of insulation.

3.3 Domestic Water Piping – Hot, Cold and Tempered

- .1 Insulate all new domestic hot, cold and tempered water piping.
- .2 Insulate valves, unions, flanges, strainers, flexible connections and expansion joints for all cold water systems. Not required for hot or tempered water systems.
- .3 Cover elbows, tees and similar fittings with equivalent thickness of insulation material.

3.4 Condensate Piping

- .1 Insulate all new condensate piping off heat pumps and other mechanical equipment, excluding boiler venting drain.
- .2 Cover elbows, tees and similar fittings with equivalent thickness of insulation material.

3.5 Roof Drainage

- .1 Insulate all roof hoppers.
- .2 Insulate all roof drainage piping including horizontal *and* vertical piping.
- .3 Insulate all drain piping located in un-insulated spaces.

3.6 Plumbing Vents

- .1 Insulate plumbing vents within 1.5 meters (5 feet) of insulated surface penetration where concealed.

End of Section

- 1 General
 - 1.1 Quality Assurance
 - .1 Water piping shall meet the requirements of the Ontario Building Code and Municipal Codes.
 - .2 Pipe fittings shall conform to the following standards:
 - .1 A.N.S.I. B36.10, A.S.T.M.-197-47 (Materials)
 - .2 A.N.S.I. B16.24, A.N.S.I./A.S.M.E. B16.15, A.N.S.I. B16.8, A.N.S.I./A.S.M.E. B16.22 (Copper Fittings)
 - 1.2 Reference Sections
 - .1 Section 22 05 01
 - .2 Section 22 07 19
 - .3 Section 22 05 29
 - 1.3 Reference Standards and Codes
 - .1 Ontario Building Code
 - .2 A.S.T.M.
 - .3 C.S.A.
 - .4 A.N.S.I.
 - .5 U.L.C.
 - .6 Local Codes and Requirements
- 2 Products
 - 2.1 Domestic Water (Aboveground)
 - .1 Domestic water pipe shall be Type "L" hard drawn copper tubing, conforming to A.S.T.M. B88.
 - .2 Fittings shall be wrought copper, solder joint, pressure type. Make soldered joints on copper tubing for potable water using lead free solder and matching flux.
 - .3 Solder to threaded adapters shall be provided at screwed valves or equipment.
 - .4 Unions shall be all bronze construction with ground joint and either solder joint or screwed ends as required. Provide dielectric unions or couplings at all connections between copper tubing and ferrous piping.

- .5 Provide commercial type water hammer arrestors on all plumbing lines serving fixtures and equipment with quick closing or solenoid valves.
 - .6 Exposed plumbing brass and metal work shall be heavy chromium plated (including under countertops without cabinets).
 - .7 Hot, cold and tempered water piping to fixtures shall be flexible copper tube complete with angle type screwdriver stop, reducer, and escutcheon plate.
 - .8 Provide isolation valves on domestic water piping to each group of fixtures.
- 2.2 Domestic water (underground)
- .1 50 millimeters (2 inches) and smaller: Copper Type K
 - .2 100 millimeters (4 inches) and larger: Listed P.V.C.
- 2.3 Water hammer arrestors
- .1 Refer to 22 42 00.
- 2.4 Solder
- .1 Potable water systems shall be lead free.
- 2.5 Condensate piping
- .1 Type "K" or "L" hard copper complete with cast brass or wrought copper drainage fittings with solder joints, or
 - .2 IPEX X.F.R.
- 2.6 Aboveground drainage, venting and storm
- .1 Pipe up to and including 50 millimeters (2 inches) for services except Urinals, where applicable, shall be:
 - .1 Copper D.W.V. pipe complete with cast brass or wrought copper drainage fittings with solder joints, use 50/50 solder and matching flux for copper drain, waste, and vent piping or
 - .2 Cast iron M.J. pipe with M.J. fittings and stainless steel clamps, (clamps shall be two-band type), or
 - .3 Drain, waste and vent P.V.C. pipe and fittings certified to C.S.A. B181.2 and tested and listed in accordance with C.A.N./U.L.C. S102.2 and clearly marked with the certification logo indicating a Flame Spread Rating not more than 25 and a Smoke Developed Classification not exceeding 50, equal to IPEX X.F.R.
 - .2 Pipe up to and including 50 millimeters (2 inches) for Urinals shall be:

- .1 P.V.C. D.W.V. for any piping underground or concealed in walls.
- .2 P.V.C. X.F.R. for any piping in pipe chases, ceilings spaces or other open areas.
- .3 Pipe 75 millimeters (3 inches) and up shall be:
 - .1 P.V.C. D.W.V. Schedule 40 System 15 complete with P.V.C. drainage fittings with solvent weld joints (in concealed areas only, not acceptable in ceilings spaces) or,
 - .2 Drain, waste and vent P.V.C. pipe and fittings certified to CSA B181.2 and tested and listed in accordance with C.A.N./U.L.C. S102.2 and clearly marked with the certification logo indicating a Flame Spread Rating not more than 25 and a Smoke Developed Classification not exceeding 50, equal to IPEX X.F.R. (where exposed or within ceiling spaces)
 - .3 Cast iron MJ pipe with MJ fittings and stainless steel clamps. Clamps shall be two-band type.

2.7 Drainage system (underground)

- .1 Pipe up to and including 75 millimeters (3 inches) shall be:
 - .1 U.L.C. certified P.V.C. 40 D.W.V. pipe to C.A.N./C.S.A. B181.2 complete with P.V.C. D.W.V. fittings to C.A.N./C.S.A. B181.2 with solvent weld joint.
 - .2 Pipe 75 millimeters (3 inches) up to and including 100 millimeters (4 inches) shall be:
 - .1 U.L.C. certified P.V.C. 40 D.W.V. pipe to C.A.N./C.S.A. B181.2 complete with P.V.C. DWV fittings to C.A.N./C.S.A. B181.2 with solvent weld joint, or
 - .2 U.L.C. certified P.V.C. SDR 28/35 B.D.S. pipe to C.A.N./C.S.A. B182.1 complete with P.V.C. B.D.S. fittings to C.A.N./C.S.A. B182.2 with solvent weld joints.
 - .3 Pipe 150 millimeters (6 inches) and up shall be:
 - .1 U.L.C. certified P.V.C. S.D.R. 28/35 sewer pipe to C.A.N./C.S.A. B182.2 complete with P.V.C. fittings to C.A.N./C.S.A. B182.2 with ring gasket joints.

2.8 Cleanouts

- .1 Refer to Section 22 13 19.

2.9 Plumbing vent stacks

- .1 Plumbing vent stack roof flashings shall be 18 inches (457 millimeters) high, vandal proof, 0.064 inches (1.6 millimeters) mill finish 1100-OT alloy aluminum, to C.S.A. B272-93, with aluminum hood and perforated collar, thick pre-molded urethane insulation liner and E.P.D.M. Base Seal, bituminous painted deck flange or to match type of roofing system. Equal to Thaler SJ-31, Stack Jack Flashing.

2.10 Firestop sealants and collars

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

3 Execution

3.1 General

- .1 Apply for permit before beginning any work. Have drawings approved for construction by authorities having jurisdiction or local agencies prior to beginning work.
- .2 Review all inverts and elevations before beginning any installation.
- .3 Do not suspend hangers including wires and rods from the steel roof deck nor from other mechanical or electrical components. Support hangers from structural bearings such as beam, top chords of steel joists or structural concrete slabs. Where structural bearings do not exist, provide angle or channel iron form nearest structural bearings to support hangers.
- .4 Refer to Section 22 05 29 for Hangers and Supports.
- .5 Have entire installation inspected, at various stages where required, to ensure approval at completion of project.
- .6 Provide clearance for proper installation of insulation and for access to components including but not limited to valves and drains.
- .7 Maintain proper grades on piping for proper drainage and provide valves at all low points.
- .8 All sanitary lines shall be sloped minimum 1 to 50 unless otherwise approved.

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- .9 All exposed piping to run parallel to walls and in a neat and orderly fashion to maintain headroom. Group piping where possible.
 - .10 Do not run combustible or non-approved pipe through fire separations or return air ceiling plenums. Use approved materials and methods only.
 - .11 Provide drain valves at low points where required.
 - .12 Install piping to allow for expansion and contraction and to eliminate stress on equipment, piping, or connections.
 - .13 Provide isolation valves or shutoff valves at all equipment.
 - .14 Provide cleanouts as indicated on drawings and as required by code. Floor cleanouts are not approved in finished floor areas unless otherwise noted. Ensure adequate clearance to all cleanouts.
 - .15 Provide sleeves for piping passing through floor slab. Caulk around piping and fill entire space between piping and floor slab with approved fire retardant material to maintain required fire rating where necessary. Refer to Section 22 05 01 for specific sealing requirements at below grade piping penetrations.
 - .16 Provide fire stop sealant at all pipe penetrations through fire separations.
 - .17 Install reduced pressure double check valve assembly to isolate domestic system from hydronic system, where indicated on drawings and as required by code.
- 3.2 Grades, Routes and Installations
- .1 All sanitary lines shall be sloped 1 to 50 unless otherwise specified.
 - .2 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space.
 - .3 Run exposed piping parallel to walls. Group piping wherever practical at common elevations.
 - .4 Install concealed pipes close to the building structure to keep furrings to a minimum.
- 3.3 Roof jacks
- .1 Provide roof jacks as required, and in compliance with the roofing specifications. Generally, S.B.S. torch down roofing requires aluminum roof jacks. Conventional bituminous roofing accepts lead or aluminum roof jacks.
 - .2 Flash pipes projecting above finished roof surface with approved material.
- 3.4 Flashing

- .1 Flash all mechanical equipment passes through weather or waterproofed walls and roofs.
- .2 Flash floor drains over finished areas by extending flashing 250 millimeters (10 inches) clear on sides. Fasten flashing to drain clamp device. Use lead sheet or approved nonmetallic waterproofing membrane.

3.5 Sleeves

- .1 Provide and set sleeves required for piping.
- .2 Set sleeves in position in advance of other work. Provide suitable reinforcing around sleeves.
- .3 Extend sleeves through potentially wet floors 50 millimeters above finished floor level. Caulk sleeves full depth and provide floor plate.
- .4 Where piping passes through floor, ceiling or wall, close off space between pipe and sleeve with noncombustible insulation or approved non-combustible insulation, fire rated as required to match the rating of the penetrated surface. Provide tight fitting metal caps on both sides.
- .5 Install chrome plated escutcheons where piping passes through finished surfaces including millwork.
- .6 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

3.6 Firestop Sealants and Collars

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

3.7 Identification

- .1 Identify all piping with type of service and arrows.

.2 Refer to Section 22 05 53.

3.8 Testing

.1 Refer to Section 22 05 92.

3.9 Cleaning

.1 Thoroughly flush domestic water systems upon completion of work.

End of Section

1 General

1.1 Submittals

- .1 Refer to Section 22 05 01 – Plumbing General Requirements.
- .2 Submit certified pump curves with shop drawings showing pump performance characteristics with pump and system operating point plotted. Include NPSH when applicable.

1.2 Quality Assurance

- .1 Pumps shall be alignment certified.
- .2 Ensure pumps operate at specified system fluid temperatures. Operate within 25 percent of midpoint of published maximum efficiency curve.

1.3 Acceptable Manufacturers

- .1 Armstrong
- .2 Bell and Gossett

2 Products

2.1 General

- .1 Statically and dynamically balance rotating parts.
- .2 The pumps shall be of the horizontal system lubricated type specifically designed and guaranteed for quiet operation.
- .3 The pumps shall have a ceramic shaft supported by carbon bearings. Bearings are to be lubricated by the circulating fluid
- .4 Pump connections shall be flanged for sizes 63 millimeters (2½ inches) and over, and grooved or union connections for sizes 50 millimeters (2 inches) and under.
- .5 Units shall be completely factory wired, tested and name-plated before shipment. Pump manufacturer shall be I.S.O.-9001 certified.
- .6 Pumps shall meet types, sizes, capacities, and characteristics as scheduled on the Equipment Schedule drawings. Refer to schedules for unit performance.
- .7 Motor stator to be isolated from circulating fluid through use of stainless steel can. Rotor to be sheathed in stainless steel..
- .8 Pumps shall be designed for operation at 225 degrees Fahrenheit and 150 P.S.I.G. working pressure unless scheduled otherwise on the drawings.

2.2 In-Line Domestic Water Circulating Pumps

- .1 Provide, as shown on the plans, Xylem – Bell and Gossett circulating pump model with lead free bronze body and Noryl impeller.
- .2 Pump shall be N.S.F. 372 certified (Lead content of all wetted surface is 0.25 percent or less.)
- .3 Electrical: 115 volt/single phase/60 hertz and c.E.T.L. listed.

3 Execution

3.1 General

- .1 Contractor shall install pumps in accordance with manufacturer's guidelines.
- .2 Install valves as per detail on drawings.
- .3 All electrical wiring and accessories, including power wiring from motor control centers and/or motor starter to driven motor, shall be installed in accordance with the requirements specified by Division 26 and the local electrical authority.
- .4 Perform startup to confirm proper operation and rotation.
- .5 Remove any temporary strainers after flushing is complete and leave in mechanical room for inspection/confirmation by the Consultant.

End of Section

- 1 General
 - 1.1 General Requirements
 - .1 Provide materials, equipment and labour to install plumbing as required by Provincial and local codes as specified herein.
 - .2 Provide water and drainage connections to equipment specified in other sections of this specification.
 - 1.2 Quality Assurance
 - .1 Provide new equipment, C.S.A. approved.
 - 1.3 Submittals
 - .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
 - .2 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
 - .3 Fixtures and Cleanouts: Dimensions and installation details
 - .4 Floor drains: Accessories, dimensions and installation details
 - .5 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.
 - 1.4 Acceptable Manufacturers:
 - .1 Watts
 - .2 Zurn
 - .3 Ancon
 - .4 Smith
- 2 Products
 - 2.1 Cleanouts and Cleanout Accessories
 - .1 Sanitary and Storm: Provide caulked or threaded type cleanouts extended to unfinished floor or wall surface. Provide bolted coverplate or threaded cleanouts on vertical rainwater leaders.
 - .2 Floor cleanout access covers in unfinished areas shall be round with nickel bronze scoriated frames and plates. Wall cleanouts shall be located behind approved access panels.
 - .3 Provide cleanout inside building at building wall where sanitary and storm services leave the building. Space cleanouts along horizontal drainage lines per O.B.C. requirements.

2.2 Floor and Trench Drains

- .1 Floor drains to be round, nickel bronze.
- .2 Floor drains to be suitable for application and environment they are installed.
- .3 Refer to Plumbing Fixture Schedule on drawings for specific models and associated tags for each location.

2.3 Trap Seal Primers

- .1 Provide electronic trap priming assemblies for areas containing multiple floor or hub drains. Coordinate final location and power requirements with Division 26. Primers shall be complete with built in backflow prevention and manifolds with sufficient quantity of ports to suit number of drains served.
- .2 Provide mechanical trap primers for single drain and/or where indicated on drawings.
- .3 Refer to Plumbing Fixture Schedule on drawings for specific models and associated tags.

2.4 Roof Drains

- .1 Roof drains shall be conventional or controlled flow type, where noted by tag number, suited for roof design/installation.
- .2 Coordinate roof type with General Contractor prior to ordering any products.
- .3 Refer to Plumbing Fixture Schedule on drawings for specific model and associated tags.

2.5 Area Drains

- .1 Area drains to be square complete with hinged grate and integral trap with cleanout plug and sediment bucket.
- .2 Floor drains to be suitable for application and environment they are installed.
- .3 Refer to Plumbing Fixture Schedule on drawings for specific models and associated tags for each location

3 Execution

3.1 Installation

- .1 Install trap primers for all floor drains and as required by codes. Refer to schedule.

- .2 Drainage lines 75 millimeters (3 inches) and less shall slope at 2 percent grade unless otherwise shown on drawings. All lines 100 millimeters (4 inches) and larger shall slope at 1 percent.

3.2 Cleanouts and Access Covers

- .1 Unless otherwise noted, floor cleanouts in finished areas are not approved.
- .2 Ensure ample clearance at cleanout for rodding of drainage systems.
- .3 Provide cleanouts at the base of each stack.

3.3 Floor Drains

- .1 Provide trap primer connected to intermittent operating cold water service on suitable fixture.
- .2 Provide sealed drains where indicated.
- .3 Set drain at elevation to allow finished floor to slope to mouth. Coordinate setting elevation with floor finish thickness and General Contractor prior to installation.
- .4 Provide flashing of sheet lead or approved nonmetallic membrane where floor drains are located over occupied spaces.
- .5 All floor drains and trap primer lines shall be covered, sealed and protected during construction to ensure construction waste or other debris does not fall in. If any drainage problems occur due to floor drains not being covered, the Contractor shall rectify at no cost to the Owner

3.4 Trap Seal Primers

- .1 Coordinate location of all trap seal primers with site and drawings.
- .2 Coordinate 120 volt power connection with Electrical Contractor.

3.6 Roof Drains

- .1 Coordinate roof drain locations with Architectural Drawings and General Contractor prior to installation. Report any discrepancies to Consultant. Any changes resulting from lack of coordination will be the Contractor's responsibility.

3.7 Area Drains

- .1 Provide trap primer connected to intermittent operating cold water service on suitable fixture.
- .2 Set drain at elevation to allow finished floor to slope to mouth. Coordinate setting elevation with floor finish thickness and General Contractor prior to installation.

- .3 All floor drains and trap primer lines shall be covered, sealed and protected during construction to ensure construction waste or other debris does not fall in. If any drainage problems occur due to floor drains not being covered, the Contractor shall rectify at no cost to the Owner

End of Section

- 1 General
 - 1.1 Related Documents
 - .1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Divisions 1 Specification Sections, apply to this section.
 - 1.2 Summary
 - .1 This section includes water source heat pump water heaters for potable water.
 - 1.3 References
 - .1 A.S.M.E. Boiler and Pressure vessel code
 - .2 I.S.O. 9001 Quality Management System
 - .3 N.F.P.A. 70- National Electric Code
 - .4 N.S.F./A.N.S.I. Standard 61- Drinking Water System Components
 - 1.4 Submittals
 - .1 Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties and accessories for each model indicated.
 - .2 Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, components, and size of each field connection.
 - .3 Wiring Diagrams: Detail for wiring power signal, differentiate between manufacture- installed and field-installed wiring.
 - .4 Maintenance Data: Include in the maintenance manuals specified in Division 1. Include maintenance guide and wiring diagrams.
 - 1.5 Regulatory Requirements
 - .1 Conform to applicable code for internal wiring of factory wired equipment
 - .2 Conform to A.S.M.E. Section VIII for heat exchanger construction
 - 1.6 Quality Assurance
 - .1 Water heater shall have U.L.-1995 certification for the entire unit.
 - 1.7 Coordination
 - .1 Coordinate size and location of concrete bases
 - 1.8 Warranty
 - .1 Equipment shall include parts warranty for 12 months from startup or 18 months from shipment.

.2 Compressors shall include 5 year parts warranty.

2 Products

2.1 Manufacturers

.1 Acceptable Manufacturers:

.1 Nyle

.2 Multistack

.3 Lochinvar

2.2 Heat Pump Unit

.1 Heat pump water heater shall be packaged water (air) source equipment, factory assembled, charged, and tested. The heat pump shall be suitable for heating potable water and have the capability of producing no less than 160 degrees Fahrenheit potable water, with published heating capacity and C.O.P. based on project specifications.

.2 Heat Pump unit shall consist of compressor, condenser, evaporator, (Optional: direct drive axial fan, direct drive centrifugal fan; air source only), hot water circulating pump, piping, and controls, factory assembled, charged, and tested.

.3 All components, including assemblies, sub-assemblies and the materials that go into constructing the heat pump water heater's potable water system must be certified for coming in direct contact with potable water, including but not limited to: piping, brazing, soldering or welding materials, circulator pump, flow sensor, temperature sensors, thread sealant, flow control valves and flat plate heat exchanger.

.4 Entire heat pump shall be U.L.1995

.5 Electrical: Unit control panel shall be U.L.1995.

2.3 Cabinet

.1 Shall be corrosion resistant epoxy coated 12-gauge aluminum. Supports, channels and beams shall also be constructed of the like. Compartments shall have large access doors for servicing. Cabinet shall be designed for outdoor operation. Cabinet shall be insulated to prevent condensation from forming on exterior surfaces.

2.4 Compressor

.1 Compressor: Hermetic scroll type by Copeland Corp., or reciprocating piston type by Carlyle Compressor suitable for high temperature operation with R-134a refrigerant. Compressor shall be furnished with service ports for suction and discharge connections.

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- .2 Compressor Controls: Compressor controls/accessories must include the following:
 - .1 High Pressure Safety monitoring
 - .2 Low Pressure Safety monitoring
 - .3 Multi-function Phase Failure Relay (Copeland Scroll)
 - .4 Active compressor mounted protection with advanced algorithms, fault history, and L.E.D. indicators. (Copeland Scroll)

 - 2.5 Condensor
 - .1 316L Stainless steel copper brazed plate vented double wall type, standard on all units. Single wall condenser construction shall not be allowed. UL Listed, NSF 61 OR 372 compliant, and suitable for up to 450°F (232°C) high temperature operation with potable water. Unit shall be operational pressure rated to no less than 435 PSI (30 Bar), with built in temperature ports for performance monitoring. Refrigerant: Refrigerant shall be R-134a.
 - .2 Refrigerant Accessories:
 - .1 Filter-Drier: Sweat connection type.
 - .2 Site Glass: Moisture indicating type.
 - .3 Liquid Line Service Valves: Bronze quarter turn type.
 - .4 Discharge Check Valve: Copper magnetic in-line type.
 - .5 Liquid Line Solenoid Valve: Electrically actuated.
 - .6 Compressor Crankcase Heater: Belly band type for scroll compressors
 - .7 Suction accumulator
 - .8 Liquid receiver

 - 2.6 Evaporator (Water Source Only)
 - .1 316L Stainless steel copper brazed plate single wall type, standard on all units. Unit shall be operational pressure rated to no less than 435 P.S.I. (30 Bar), with built in temperature ports for performance monitoring. Refrigerant: Refrigerant shall be R-134a.

 - 2.7 Expansion Valve
 - .1 Thermal expansion valve shall be specifically designed for heat pump use with field adjustable superheat feature.

 - 2.8 Anti-Short Cycle Control

-
- .1 Anti-Short Cycle Control: Units shall be factory wired to allow a maximum of twelve compressor starts per hour to prevent compressor short cycling and allow time for suction and discharge pressures to equalize permitting the compressor to start in an unloaded condition.

2.9 Controls

- .1 The Heat Pump Unit Shall offer an optional P.L.C. Controls
- .2 Timed Short Cycle Control
- .3 Panel Mount Control Touch Screen
- .4 Access Level Control
- .5 Internal Or External Aquastat Controls
- .6 Resettable Compressor Run Times
- .7 Low Temperature Freeze/Flow Monitoring
- .8 Flow Rate Meter for Potable Water
- .9 Phase Failure Monitoring (scroll type compressors)
- .10 100 Fault Memory
- .11 Systems Performance Monitoring
- .12 B.M.S. Compatibility With Varied Protocol Options
- .13 Bacnet M.S.T.P.
- .14 Bacnet Ethernet
- .15 Modbus M.S.T.P. Built In
- .16 Slave units must be in a master or slave identifiable configuration, capable of being arranged in arrays. Communications between units shall be inherent ethernet. Units shall have built in lead lag compatibility. P.L.C. shall monitor and control automated active and passive defrost, and wetted component freeze protection.

2.10 Constant Leaving Water Temperature Control

- .1 Constant Leaving Water Temperature Control (Single-Pass only): Heat pump shall be factory equipped with electronic temperature control valve which automatically maintains constant leaving water temperature regardless of entering water temperature. Leaving water temperature is set by the heat pump operator/user via the field adjustable touch screen interface.

3 Execution

3.1 Installation

- .1 Install water heaters level and plumb in accordance with manufacturers written instructions and referenced standards.

3.2 Start-up

- .1 Start up on the unit will be performed by factory trained and authorized personnel. A copy of the startup report will be provided to the owner and factory.

End of Section

- 1 General
 - 1.1 Requirements
 - .1 Plumbing fixtures shall meet the following requirements where applicable:
 - .1 Ontario Building Code
 - .2 Local Codes and Requirements including barrier free
 - 1.2 Codes and Standards
 - .1 C.A.N. 3-B45
 - .2 C.S.A. B125
 - 1.3 Submittals
 - .1 Shop Drawings:
 - .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
 - .2 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
 - .3 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.
 - .2 Operation and Maintenance Data:
 - .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
 - .2 Operation and maintenance data shall be included in the maintenance manual.
- 2 Products
 - 2.1 Fixtures
 - .1 Determine fixture quantity and location from Architectural Drawings. Refer to and provide plumbing fixtures as per schedule.
 - .2 Refer to Section 22 05 01 for mounting heights. Coordinate with Architectural Drawings and General Contractor prior to installation.
 - .3 Report any discrepancies of fixtures and mounting heights between Architectural Drawings and Plumbing Drawings/Schedule/Specification to the Consultant.
 - .4 Plumbing Fixtures shall be approved for intended application.

- .5 Fixtures and trim of same type to be of one manufacturer.
- .6 Where particular fixture or piece of trim is identified by a manufacturers' catalogue designation this reference is to establish standard and fixture or trim from manufacturers listed below is equally acceptable when conforming to the same level of quality.
- .7 Finished surfaces to be clear, smooth and bright, and guaranteed not to craze, discolour or scale.
- .8 Visible parts of faucets, escutcheons, wastes, strainers, traps, shower heads, supplies and stops to be chrome plated.
- .9 Floor mounted water closets to be fitted with china bolt caps.
- .10 Tank water closets to be fitted with bolt on lid.
- .11 Swing spouts for sinks shall be sized so spout does not swing beyond sides of bowl. Spouts for sinks shall have stopper to prevent spout from swinging past back of bowl.
- .12 Water supply faucet spouts to be fitted with modulators (non-aerating).
- .13 Fixtures to be ordered to suit construction schedule.
- .14 Acceptable Manufacturers:
 - .1 Vitreous China (water closets, urinals and lavatories): American Standard, Kohler, Vortens
 - .2 Wall Carriers: Watts, Zurn
 - .3 Toilet Seats: Centoco, Bemis, Olsonite
 - .4 Faucets: Commercial Moen, Sloan, Cambridge Brass, Delta
 - .5 Stainless Steel Sinks: Franke/Kindred, Steel Queen, Elkay
 - .6 Washfountains: Bradley, Acorn, Elkay
 - .7 Drinking Fountains: Oasis (Bottle Filler with Cooler)
 - .8 Mop Sinks: Stern Williams, Fiat, Elkay, Acorn
 - .9 Eyewash Stations: Haws, Speakman, Guardian, Bradley
 - .10 Hosebibbs: Watts, Zurn
 - .11 Thermostatic Mixing Valves: Lawler, Haws, Symmons, Powers

2.2 Trim

- .1 Provide trim for plumbing fixtures as per schedule.
- .2 Trim to be suitable for exposed piping application where applicable.

.3 Acceptable Manufacturers: Cambridge Brass, Delta, Zurn, McGuire

2.3 New Plumbing Fixture Schedule

WC-1 Toilet – Floor Mounted – Vitreous China – For Manual Exposed Flushometer – Barrier Free

American Standard Madera Flowise Right Height Elongated 3461.001.020 HET Toilet, 419 millimeters high, white vitreous china with EverClean antimicrobial surface which inhibits the growth of stain and odor causing bacteria mold and mildew, Floor Mounted, siphon jet flush action, operates in the range of 4.2 litre to 6 litre (1.1 U.S. Gallon to 1.6 U.S. Gallon) per flush, condensate channel, 305 millimeters by 254 millimeters (12 inches by 10 inches) water surface, elongated bowl, 54 millimeters (2-1/8 inches) fully glazed internal trapway, floor outlet, bolt caps, 38 millimeters (1-1/2 inches) diameter Top spud. Co-ordinate F.V. height with grab bars. (see arch. drawings)

Centoco AM820STSS-001 self sustaining toilet seat, extra heavy duty, for elongated bowl, open front, solid plastic with antimicrobial surface, with cover, stainless steel check hinges, metal flat washers stainless steel posts and nuts.

Moen 8310M16 ,1-1/2 inches Manual Exposed Style Closet Flush, Manual exposed water closet flushometer with brass angle stop valve, Cast brass construction with chrome electroplated finish, Chloramines resistant seals, 1 inch I.P.S. inlet supply, 1-1/2 inch top spud, High back pressure vacuum breaker, Diverter valve support, A.D.A. compliant handle with dual o-ring seals, Operating pressures: 15 to 120 p.s.i., AccuSet piston technology, Self-cleaning filter Valve,

Alternates: Kohler, Crane. Seats: Moldex, Olsonite, Beneke. Flush Valve: Moen Only

LV-1 Lavatory – Counter Mounted – Undermount – Wide Spread

American Standard Studio 0614.000- Nominal Dimensions: 19-3/4 inches by 13-3/4 inches (502 x 350 millimeters) Bowl size: 18 inches (457 millimeters) wide 12 inches (305 millimeters) front to back 6-7/16 inches (164 millimeters) deep Rectangular under counter mount sinks, Made from vitreous china, Unglazed rim, Front overflow, Supplied with mounting kit

and template

Moen Banbury WS84924, Two-Handle Widespread Lavatory Faucet, Duralock quick connect installation, Metal construction with various finishes identified by suffix, ½ inch I.P.S. connections, Includes non-metal pop-up waste assembly, Lever style handles, 1.2 g.p.m. maximum (4.5 litre per mininte) at 60 p.s.i.

McGuire 155MP Pop Up Plug Drain, Plug with cast brass follower, chrome plated cast brass one piece top, 17 gauge. (1.5 millimeters) tubular 32 millimeters (1-1/4 inches) tailpiece.

McGuire LFH165LKN3, Faucet Supplies, chrome plated polished brass, heavy duty angle stops, 10 millimeters (3/8 inch) I.P.S. Inlet by 76 millimeters (3 inches) long rigid horizontal nipples, V.P. Loose keys, escutcheon and flexible copper riser. One supply required if fed mixing valve.

McGuire 8872C P-Trap, heavy cast brass adjustable body, with slip nut, 32 millimeters (1-1/4 inch) size, shallow wall flange and seamless tubular wall bend.

LV-2

LAVATORY - BASIN - WALL HUNG - VITREOUS CHINA - TWO HANDLE FAUCET - BARRIER FREE

American Standard #9960.803 Mezzo, Semi - Countertop Sink, Faucet holes on 8 inches, Bowl sizes: 19 inches (482 millimeters) wide 5 inches (381 millimeters) front to back 6-7/8 inch (175 millimeters) deep, Space saving design installs on a minimum countertop depth of 13 inches, Made from fire clay china ,Rear overflow, Recessed self-draining deck, Barrier-free design, Self rimming with sealant, Cutout template and mounting

Moen Commercial faucet, 4 inch centerset metering faucet, Model 8886 Chrome plated solid brass construction, A.D.A. compliant lever style handles, 5 to 60 second cycle time, 0.5 g.p.m. (1.9 liters pre minute) maximum, vandal-resistant multi-stream laminar flow, A.S.M.E. A112.18.1/C.S.A. B125.1 certified. provide a minimum of 10 seconds cycle time.

McGuire 155A Open Grid Drain, chrome plated cast brass one piece top, 17 gauge. (1.5 millimeters) tubular 32 millimeters (1-1/4 inches) tailpiece. McGuire 155A Open Grid Drain, chrome plated cast brass one piece top, 17 gauge (1.5 millimeters)

tubular 32 millimeters (1-1/4 inches) tailpiece.

McGuire LFH165LKN3, Faucet Supplies, chrome plated polished brass, heavy duty angle stops, 10 millimeters (3/8 inch) I.P.S. Inlet x 76 millimeters (3 inch) long rigid horizontal nipples, V.P. Loose keys, escutcheon and stainless steel braided flexible riser.

McGuire 8872C P-Trap, heavy cast brass adjustable body, with slip nut, 32 millimeters (1-1/4 inch) size, shallow wall flange and seamless tubular wall bend.

Watts CA-462, Fixture Carrier, wall mounted, adjustable epoxy coated cast iron wall plate and arms.

Alternates: Kohler, Crane. Trim: Chicago Faucets, Emco, American Standard, Moen Commercial. Carriers: Jay R. Smith, Zurn.

SK-1

Kitchen Sink – Double Bowl Sink – Countertop with Ledgeback – Standard use – Two Handle Faucet

Franke Commercial #BD6410PCB-1/3. 20-13/16 by 31 ¼ inches overall. 16 by 14 by 10 inch Bowl. (F.B. by L.R. by D.). 529 x 794 millimeters Overall. 406 by 356 by 254 millimeters Bowl. (F.B. by L.R. by D.), 18-gauge, Double compartment self rimming top mount sink with faucet ledge. 18 gauge (1.2 millimeters), type 304 (C.N.S. 18/10) stainless steel. Exposed surfaces are #4 satin finished. Undercoated to reduce condensation and resonance. Includes waste fittings, factory applied rim seal, cutout template, and factory installed EZ TORQUE™ fasteners. Certified to A.S.M.E. A112.19.3-2008 / CSA B45.4-08. Centre back waste location. Includes 3 ½ inches (89 millimeters) crumb cup strainer with 1 ½ inches (DN38) brass tailpiece.

Moen Commercial 8282 Deckmount Two handle manual faucet, 8 inches (203 millimeters) centerset, lead free chrome plated solid brass with one piece concealed rough body, ceramic 1/4 turn cartridges, 8 inch (203 millimeters) swing spout, 1.2 g.p.m. maximum (4.5 litres per minute) at 60 p.s.i., metal red and blue index buttons, 4 inches (102 millimeters) lever style handles with hot and cold colour indicators and vandal resistant screws.

McGuire LFH165LKN3, Faucet Supplies, chrome plated polished brass, heavy duty angle stops, 10 millimeters (3/8 inches) I.P.S. Inlet by 76 millimeters (3 inches) long rigid horizontal nipples, V.P. Loose keys, escutcheon and flexible copper riser.

McGuire 8912CB P-Trap, heavy cast brass adjustable body, with slip nut, 38 millimeters (1-1/2 inches) size, box flange and seamless tubular wall bend.

Alternates: Kindred Commercial, Architectural Metal Products.
Trim: Delta, Emco, American Standard, Moen Commercial.

SK-2 Service Sink – Single Compartment Sink – Scullery Sink

FRANKE SL2424-5/2, 2 faucet holes, 1 1/4 inches diameter, 8 inches centreset, Single compartment scullery sink. 27 3/16 x 27 3/8 inches Overall. 24 by 24 by 14 inches Bowl. (F.B. by L.R. by D.). 691 by 695 millimeters Overall. 610 by 610 by 356 millimeters Bowl. (F.B. by L.R. by D.) 16 gauge (1.5 millimeters), type 304 (C.N.S. 18/10) stainless steel. Polished to a #4 satin finish. Sink compartment sloped to drain with radius coved corners on front and back only. Rolled rim. Stainless steel tubular legs with adjustable feet. Includes waste fitting. Certified to A.S.M.E. A112.19.3-2008/C.S.A. B45.4-08 Right rear waste location. Includes 1 1/2 inches (38 millimeters) duplex waste assembly with rubber stopper and 1 1/2 inches (DN38) brass tailpiece, with standpipe and guard.

Moen Commercial 8124 Wall Mount Service Sink Two handle manual faucet, adjustable 8 inches (203 millimeters) centreset, lead free chrome plated solid brass with one piece concealed rough body, unrestricted 3/4 inch (19 millimeters) hose end outlet, 10-1/4 inches (260 millimeters) from wall to outlet reach, integral atmospheric vacuum breaker, 2-1/2 inches (64 millimeters) lever style handles with hot and cold colour indicators and vandal resistant screws. Wall brace support and pail hook.

SK-3 HAND SINK – SINGLE BOWL – WALL HUNG – HANDWASH SINK KIT

FRANKE WT500C-7, Bowl Height 5 9/16 inches, Bowl depth 11 7/16 inches, Bowl width 15 3/4 inches, Material thickness 1/16 millimeters, Overall depth 17 9/16 inches, Overall height 5 15/16 inches, Overall width 19 11/16 inches, Stainless Steel Single

wash basin for wall mounting, stainless steel, surface satin finished, material thickness 1 millimeters (19 gauge), seamless welded bowl with diameter 400 x 300 x 135 millimeters, rectangular shape, 105 millimeters tap ledge, front panel with 45° corner edges, pre-welded mounting brackets, mounting conform E.N. 31, including screws and dowels

Moen 8948 Two Handle Clinic Faucet , DESCRIPTION: 2 holes, 1 inch minimum diameter, and 4 inches on center, Chrome plated metal construction, ½ inch I.P.S. connections, Supplied with vandal resistant screws, Valve body is of brass construction. OPERATION, Wrist Blade style handles with hot and cold color indicators, Hot side counterclockwise (1/4) turn to open clockwise to close, Cold side clockwise (1/4) turn to open, counterclockwise to close. FLOW, Water usage is limited to these maximum flow rates as indicated by the corresponding product markings, 1.2 g.p.m. maximum (4.5 liters per minute) at 60 p.s.i. CARTRIDGE ,1224 cartridge design, Nonmetallic and stainless steel construction.

SH-1 SHOWER – CORNER WALL SET

Moen T2812 , Rizon, posi-temp single-handle shower trim kit

Includes showerhead, arm, flange and diverter spout, Includes Red/Blue indicators, Lever style handle with temperature indicator on the escutcheon, Handle operates counterclockwise through a 270 degree arc with off at 6 o'clock and maximum hot at the 9 o'clock position. Shut off in clockwise direction, Adjustable temperature limit stop to control maximum hot water temperature, Pressure balancing mechanism maintains selected discharge temperature to ± 3.6 degrees Fahrenheit (±2 degrees Celcius) Showerhead is limited to 2.5 g.p.m. (9.5 liters per minute) at 80 p.s.i. 1222 cartridge design, Nonmetallic/nonferrous and stainless steel materials.

Neo-Round Base, Acrylic Corner Shower Base

MODEL NUMBER: 101428-000-001, Dimensions: 40.125 inches by 40.125 inches by 4.125 inches, Color: white, Low threshold base, Corner drain; textured bottom, deflecting strip preventing water penetration behind the shower, Corner installation, Walls not required.

Radia Neo-round, 6 millimeter Sliding Shower Door for Corner Installation with Clear glass in Chrome

MODEL NUMBER: 137445-900-084-000, Dimensions: 40 inches by 40 inches by 71.5 inches, 6 mm tempered glass with Lotus glass protection, Magnetic and P.V.C extrusion for a better watertight closure, Easy to detach the bottom wheels to clean the track (Clip and Push), 3/4 inch of out of plumb adjustment.

ZURN FD2275, 2 inch P.V.C. floor drain, 4-1/4 inch round stainless steel strainer

SH-2

SHOWER - VALVE AND HANDSHOWER - BARRIER FREE DESIGN

Moen T8346, Single-Handle Posi-Temp Handheld Shower System,

Metal and brass construction with Chrome plated nish, Pressure balancing cycle valve, Contains: hand-held shower, with non-positive pause, 30 inches slide bar, drop ell, 72 inches metal hose and mounting hardware, Supplied with vandal resistant screws, Quick cleaning rubber nozzles, Temperature valve has ADA compliant lever style handle, Handle operates counterclockwise through a 270 degree arc with off at 6 o'clock, and maximum hot at the 9 o'clock position. Shut off in clockwise direction, Adjustable temperature limit stop, Pressure balancing mechanism maintains selected discharge temperature to ± 3.6 degrees, Single function spray pattern, Easy to operate pause button (reduces the flow of water to a trickle, 2.5 g.p.m. (9.5 liters per minute) maximum at 80 p.s.i.

Cartridge 8372HD: 1/2 inch IPS connection with integral stops

DF-1

DRINKING FOUNTAIN - COOLER - BOTTLE FILLER - VANDAL RESISTANT

Elkay EZH20 System EZ8WSSSMC, barrier free, bottle filling station, Refrigerated Surface Mount Bottle Filling Station, Non-Filtered 8 G.P.H. Stainless. Chilling Capacity of 8.0 G.P.H. (gallons per hour) of 50 degrees Fahrenheit drinking water, based on 80 degrees Fahrenheit inlet water and 90 degrees Fahrenheit ambient, per A.S.H.R.A.E. 18 testing. Features shall

include Antimicrobial, Hands Free, Laminar Flow, Real Drain. Electronic Bottle Filler Sensor activation. Product shall be Wall Mount (On Wall), for Indoor applications, serving 1 station(s). Unit shall be certified to U.L. 399 and C.A.N./C.S.A. C22.2 No. 120. Unit shall be lead-free design which is certified to N.S.F./A.N.S.I 61 and 372 (lead free) and meets Federal and State low-lead requirements.

McGuire LFHST11LK, drinking fountain supply, chrome plated polished brass, straight stops, 10 millimeters (3/8 inches) I.P.S. Inlet, V.P. Loose keys.

McGuire 8872C P-Trap, heavy cast brass adjustable body, with slip nut, 32 millimeters (1-1/4 inches) size, shallow wall flange and seamless tubular wall bend.

MS-1 SERVICE / MOP SINK - TWO HANDLE - MANUAL FAUCET

Stern Williams MTB-2424 square Service/Mop Sink, 610 millimeters (24 inches) by 610 millimeters (24 inches) by 254 millimeters (10 inches) deep, Floor Mounted, terrazzo composed of pearl gray marble chips and Portland cement ground smooth, sealed to resist stain, cast brass drain with stainless steel strainer, 3 inches(75 millimeters) outlet.

Moen Commercial 8124 Wall Mount Service Sink Two handle manual faucet, adjustable 8 inches (203 millimeters) centerset, lead free chrome plated solid brass with one piece concealed rough body, unrestricted 3/4 inch (19 millimeters) hose end outlet, 10-1/4 inches (260 millimeters) from wall to outlet reach, integral atmospheric vacuum breaker, 2-1/2 inches (64 millimeters) lever style handles with hot and cold colour indicators and vandal resistant screws. Wall brace support and pail hook.

Stern Williams V-70 Bumper Guard extruded vinyl.

Stern Williams T-35 Hose and Wall Hook 36 inches (914 millimeters) long hose with 3/4 inch (19 millimeters) chrome coupling, stainless steel wall bracket.

Stern Williams T-40 Mop Hanger stainless steel #4 finish, 24 inches (610 millimeters) long with 3 rubber spring loaded clips.

Stern Williams BP Back Splash Panel 20 gauge type 304 stainless steel.

Stern Williams TC-3 Gasket 3 inches (76 millimeters) for X.H.C.I., plastic and steel pipe.

Provide P-Trap, same material as the connecting pipe drain.

ES-1 EMERGENCY SHOWER – DECONTAMINATION SHOWER

Haws Model 8123 drench shower, for horizontal or vertical installation shall include the AXION M.S.R. hydrodynamic design stainless steel showerhead with 20 g.p.m. flow control, chrome-plated brass stay-open ball valve equipped with stainless steel ball and stem, stainless steel pull rod with triangular handle, universal sign. Complete with Haws model 9010 testing curtain.

FD FLOOR DRAINS - FINISHED AREA - ADJUSTABLE STRAINER

Watts FD-100-C-7-5-1 Floor Drain - epoxy coated, cast iron body, reversible flashing clamp with primary and secondary weepholes, trap primer connection with plug, no hub outlet.

Watts -5-1 5 inches (127 millimeters) diameter, nickel bronze, adjustable heavy duty round strainer.

Alternates: Jay R. Smith, Zurn.

AD AREA DRAIN - DECONTAMINATION SHOWER

Watts FD-430 Area Drain - epoxy coated steel side outlet area drain with anchor flange, 12 3/4 inches by 12 3/4 inches(324 by 324) square epoxy coated heel proof ductile iron hinged grate, integral trap with clean-out plug, sediment bucket, and no hub (standard) outlet.

CO CLEANOUT - FLOOR CLEANOUT

Watts CO-200-R-34G Cleanout - epoxy coated, cast iron body, 5 inches (127 millimeters) round adjustable gasketed nickel bronze top, ABS plug with neoprene gasket, no hub outlet.

Alternates: Jay R. Smith, Zurn.

TSP-1 TRAP SEAL PRIMERS

Sioux Chief 695-ES01, surface mount electronic trap primer,

single outlet, solenoid valve, vacuum breaker, configurable electronic primer controller, water hammer arrestor, 120 V.A.C. power, 1/2 inch (13 millimeters) inlet and outlet. Provide manifold as required to suit number of traps.

EW-1 EMERGENCY EYE WASH - WALL MOUNTED

Haws model 7360BT-7460BT wall mounted eye/face wash. Stainless steel 11 inches (27.9 centimeters) round bowl, an AXION M.S.R. eye/face wash head shall feature inverted directional laminar flow which achieves Zero Vertical Velocity™ supplied by an integral 3.7 g.p.m. flow control, chrome-plated brass stay-open ball valve equipped with stainless steel ball and stem, and chrome-plated brass in-line 50 by 50 mesh water strainer. Unit shall also include cast-aluminum chromate protected wall bracket, drain trap and tailpiece, yellow plastic pop-off dust cover for eyewash head, tailpiece and trap, universal sign, 1/2 inch N.P.T. inlet, and 1-1/2 inches N.P.T. waste. SP170 green waterproof test card used to record weekly testing.

TMV-1 THERMOSTATIC MIXING VALVE - EMERGENCY USE

Haws Model 9201H thermostatic mixing valve, mixes hot and cold water to supply tepid water to a single emergency safety shower requiring flow of 20 g.p.m. (76 liters per minute). Unit employs a paraffin filled thermostatic mixing element. Positive shut off actively suspends hot water when cold water supply is lost to prevent against scalding. Lead free certified to N.S.F. 61. Conforms to A.S.S.E. 1071, A.N.S.I. Z358.1 and C.S.A. B125.3. Adjustable factory preset outlet temperature of 85F. 1 inch N.P.T. inlets and 1-1/4 inches outlet.

TVM-2 THERMOSTATIC MIXING VALVE - POINT-OF-USE VALVE

Lawler TMM-1070, bronze body construction, high temperature limit stop with shut off temperature of 118 degrees (+/- 3 degrees Fahrenheit), integral rubber duck-bill back-flow checks within inlets, temperature adjustment dial, thermostatic mechanical mixing valve with outlet temperature range within 95 to 1155 degrees Fahrenheit) (35 to 46 degrees Celsius), A.S.S.E. 1070 approved, valve shall control temperature from a low of 1/2 g.p.m., 1 g.p.m. at 10 p.s.i. and 1.6 g.p.m. at 20 p.s.i. drop across the valve, 3/8 inch diameter compression fit inlets

and outlets, A.S.S.E. Lead Free Certified.

Alternates: Symmons, Powers, Leonard, RADA.

HB- 1 HYDRANTS - NON-FREEZE

Watts HY-725 Hydrant non-freeze hydrant, all bronze head, seat casting and internal working parts wall mount hydrant, concealed, bronze wall casing, chrome plated face, integral vacuum breaker, nickel bronze box and door, loose key, 3/4 inch (19 millimeters) diameter hose connection, 3/4 inch (19 millimeters) female x 1 inch (25 millimeters) male pipe connection. Wall thickness to be confirmed by contractor at time of ordering.

HB-2 HYDRANTS - INDOOR

Acorn 8121-SSLFCR Hydrant - with flange, stainless steel lead free and atmospheric vacuum breaker. Hose valve, replaceable cartridge, rough chrome plated finish, brass body, vandal-resistant lock shield bonnet, removable wheel handle. 3/4 inch diameter (19 millimeters) N.P.T. female inlet, 3/4 inch diameter (19 millimeters) male hose thread outlet.

OI-1 OIL INTERCEPTOR

Watts OI-7100-XHD-x recessed oil interceptor. floor mounted epoxy coated steel oil interceptor with integral storage tank, gasketed epoxy coated steel skid-proof cover secured with hex head center bolt(s), deep seal trap with cleanout, draw-off connection and dual vent connections, sediment bucket, integral stainless steel flow control plate, and no hub (standard) connections, extra heavy-duty cover, extension as required.

TD TRENCH DRAIN

Northstar Industries MEADRAIN Systems EN2000, presloped, manufactured from polymer concrete, less than 0.05 percent water absorption, sealable channel groove, interlocking joint system. 240 millimeters overall width with 200 millimeters clear opening. Complete with stainless steel, slotted grating with minimum class D. 400 rating (40,000 kilogram) and In-Line catch basin with trash bucket. Contractor shall site measure and provide complete system layouts with manufacturer drawings, including inverts and outlet connection sizes at shop drawing

review.

Alternates: A.C.O. Drain.

RD ROOF DRAINS - STANDARD FLOW

Smith Series 1010ERCCID Roof Drain, all duco coated 15-1/4 inches (387 millimeters) diameter cast iron body, with under deck clamp, solid extension and sump receiver, flashing clamp with seepage openings and 11 inches (280 millimeters) diameter secured cast iron dome. (Solid extension height to suit roof construction).

Alternates: Watts, Zurn

WATER HAMMER ARRESTORS - PPP SC SERIES

P.P.P. SC Series Water Hammer Arrestor, barrel-fabricated of type "L" hard drawn copper, machined of free turning brass, attached to barrel with 95-5 solder cap, polycarbonate DOW Caliber 2016-15 MFR piston, EPDM o-rings, Dow-Corning Silicone Compound #111, F.D.A. listed for use in potable water system lubricant, nickel plated for salt water application, designed to operate on all domestic and commercial systems. Normal operating pressure 0 to 200 p.s.i.g., max spike pressure of 400 p.s.i.g., machined of C 96300ECO lead free brass threaded adapter, may be installed in new or existing plumbing systems with a standard pipe tee. Maintenance free-the piston is the only moving part. Size according to manufacturer's recommendations to eliminate water hammer and shock from piping system. Provide Water Hammer Arrestors on hot and cold water supplies to all quick valves, solenoids, and plumbing fixtures, and locate in an upright position between the last two fixtures on a line, or horizontally at the end of line closest to supply source

ACCESS DOORS/COVERS - FLUSH ACCESS DOOR - BAKED ENAMELLED

Acudor UF-5000 SC - universal flush, flush to frame door with rounded safety corners, 16 gauge up to 16 inches by 16 inches; 14 gauge over 16 inches by 16 inches, 12 inches by 12 inches (305 millimeters by 305 millimeters). One piece frame outer flange welded to mounting frame, 18 gauge up to 16 inches by 16 inches; 16 gauge over 16 inches by 16 inches. Continuous,

concealed hinge, stainless steel screwdriver operated cam latch. Doors in tile walls shall be stainless steel and shall suit tile pattern. All other panels shall be prime painted steel. Minimum size of panels in wall shall be 12 inches by 12 inches (300 millimeters by 300 millimeters). minimize size of panels in ceilings shall be 18 inches by 18 inches (450 millimeters by 450 millimeters).

ACCESS DOORS/COVERS - RECESSED ACCESS DOOR - FOR DRYWALL

Acudor DW-5040 SCPC - flush to surface for drywall, satin coat steel with white baked enamel finish, formed door panel, flanged on four sides, 20 gauge. Galvanized frame with multiple bends and integral taping bead, 26 gauge. Concealed hinge, stainless steel screwdriver operated cam latch. Minimum size of panels in wall shall be 12 inches by 12 inches (300 millimeters by 300 millimeters). minimize size of panels in ceilings shall be 18 inches by 18 inches (450 millimeters by 450 millimeters).

3 Execution

3.1 Installation

- .1 Support fixtures level and square and connect with supplies, drains, traps and vents. Provide trap easily accessible for service and cleaning.
- .2 Hot water taps to be on left side.
- .3 Fixtures on outside walls to have water supplies in insulated chase.
- .4 Exposed supply tail pieces, drains and traps on handicapped fixtures are to be insulated and/or covered in conformance with the Ontario Building Code.
- .5 Completely remove and reinstall existing fixtures which are indicated to remain and connect to drain, vent, hot and cold water supply piping, to approval of authorities. Provide new seals and "O" rings.
- .6 Accurately lay out roughing-in. Offsets will not be accepted.
- .7 Provide fixtures complete with necessary trim, including traps, faucets, supplies, stops, strainers and escutcheons. Any exposed trim shall be chrome.
- .8 Provide chrome plated rigid or flexible connections with screwdriver stops,

reducers, and escutcheons.

- .9 Provide trap easily accessible for service and cleaning.
- .10 Provide independent threaded check valves on the hot and cold water supply lines to all thermostatic and pressure balancing faucets prior to mixing valves.
- .11 Provide hot water recirculation lines within 1200 millimeters (48 inches) of all plumbing fixtures equipped with thermostatic mixing valves.
- .12 Seal fixtures and trim to counters using continuous strip of "Plumber's Dope".
- .13 Install vacuum breakers on plumbing lines where contamination of domestic water may occur. Generally necessary on flush valves and janitor sink trim and shall be integral to fixtures as per schedule.
- .14 Install prefabricated shower units with additional support by applying a heavy donut or furrow of wet cement, just prior to unit installation and level unit so that the cement will form a firm support between the floor and the unit.
- .15 Provide caulking around mounting face to seal with clear or white silicone.
- .16 Thoroughly clean all plumbing fixtures and trim at completion of the project.

3.2 Fixture Supports

- .1 Install wall mounted fixtures with approved wall carriers, model to suit installation.
- .2 Provide plates, brackets, wall carriers, cleats, and supports to rigidly secure fixtures in place.
- .3 Fasten wall brackets with bolts attached to double steel supporting plates.
- .4 Bolt fixture to wall through cored holes under lavatory wall flange, using chrome plated carriage bolts with integral washers, and expansion shields.
- .5 Install extra heavy chair carriers for fixtures not directly supported from floor.
- .6 Conceal vertical supports and baseplates in wall construction.
- .7 All floor mounted plumbing fixtures (such as water closet bowls, service sinks, mop receptors, and pre-fabricated shower units) to be set in mastic.

3.3 Mounting Heights

- .1 Refer to Section 22 05 01 and Architectural Drawings/Details for mounting heights. Report any discrepancies.

3.4 Protection

- .1 Plumbing fixtures and trim to be covered with plywood, cardboard or heavy paper and kept protected before, during and after installation and until work is completed and accepted.
- .2 Clean fixtures and trim immediately prior to building completion.

End of Section

1 General

1.1 General Requirements

- .1 The requirements of this section shall apply to all sections in Division 23.
- .2 Conform to Division 1 General Conditions.
- .3 All material, labour, equipment, and services required under this section shall be the full responsibility of the Mechanical Contractor including any material, labour, equipment, and services provided by their subcontractors.
- .4 Complete and submit the Supplemental Tender Form including list of equipment and materials to be used on this project and forming part of the tender documents.

1.2 Definitions

- .1 “Supply” shall mean supply only.
- .2 “Install” shall mean install and connect.
- .3 “Provide” shall mean supply, install, and connect.
- .4 “Drawings and Specifications” shall mean Contract Documents.
- .5 “Authorities” or “Authorities having jurisdiction” shall mean all agencies that enforce the applicable laws, ordinances, rules, regulations, or codes of the Place of Work.
- .6 “Work” shall mean all equipment, materials, labour, and permits to provide a complete and operational mechanical system as detailed in the drawings and specifications.
- .7 “Owner” or “CoP” shall mean the City of Peterborough.

1.3 Related Work

- .1 Division 1 – General
- .2 Division 22 - Plumbing
- .3 Division 26 – Electrical
- .4 Division 28 – Communications
- .5 Division 23 specifications form a part of the Contract Documents and shall be read, interpreted, and coordinated with all other Divisions.

1.4 Intent

- .1 The drawings and specifications are not a detailed set of installation instructions. Drawings and specifications are complementary to one

another and that which is shown on one is as binding as that which is shown on both.

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

1.5 Codes, Bylaws, Standards, and Regulations

- .1 The mechanical system shall comply with the latest editions and revisions of applicable codes, bylaws, standards, and regulations including but not limited to:
 - .1 Ontario Building Code
 - .2 A.S.H.R.A.E.
 - .3 S.M.A.C.N.A.
 - .4 N.F.P.A.
 - .5 Canadian Standards Association
 - .6 Canadian Gas Association

- .7 Local Building Bylaws
 - .8 Ontario Occupational Health and Safety Act
 - .2 Provide work in accordance with the requirements of all applicable government codes, local by-laws, underwriter's regulations base building standards, contract documents, and all authorities having jurisdiction.
 - .3 Where discrepancies occur between contract drawings and specifications and above codes and standards referred to herein, the Contractor is to notify the Consultant in writing and obtain clarification prior to proceeding with the work.
 - .4 Contractors shall not reduce the requirements on the contract drawings and specifications by applying any codes and standards referred to herein.
- 1.6 Permits and Fees
- .1 Apply for, obtain, and pay for all permits, fees, connections, inspections, licenses, certificates or charges necessary including all provincial and federal taxes.
 - .2 Coordinate all required inspections and give necessary notice to all authorities.
 - .3 Upon completion of project, provide inspection certificates confirming acceptance by all authorities having jurisdiction for all applicable disciplines.
- 1.7 Contract Breakdown
- .1 After the tenders close, submit a breakdown of the price into scope and trades to the satisfaction of the Consultant based on the sections of the specifications.
 - .2 Breakdown shall include but not be limited to:
 - .1 Mobilization and shop drawing submission (maximum \$2,000.00)
 - .2 Underground plumbing and drainage (including storm)
 - .3 Above ground plumbing and drainage
 - .4 Plumbing Fixtures
 - .5 Boilers
 - .6 Pumps
 - .7 Heat Exchanger and/or Glycol Equipment
 - .8 Heating Piping

- .9 Pipe Insulation
 - .10 Snow melting equipment
 - .11 Fans
 - .12 Grilles and Diffusers
 - .13 Ductwork
 - .14 Duct Insulation
 - .15 Controls
 - .16 Testing, Startup & Training
 - .17 Balancing
 - .18 Close-out Submittals – Manuals and As-builts (minimum \$3,500.00)
 - .3 Progress claims shall be based on the breakdown. Submit in table format showing contract amount, work complete to date as percentage, previous draw, amount this draw and balance for each line item.
- 1.8 Shop Drawings
- .1 Within thirty (30) days of award, the Contractor shall submit shop drawings of all equipment for the project. Partial submittals will not be accepted.
 - .2 Prior to ordering of products or delivery of any products to job site, submit shop drawings electronically in PDF format to the Consultant for review and comments. Submit sufficiently in advance of construction to allow ample time for review. Size of shop drawings shall be 8.5 by 11 inches. 11 by 17 inches will be acceptable where appropriate for content and scale.
 - .3 Submittals shall contain but not be limited to:
 - .1 Construction information
 - .2 Product data
 - .3 Performance data including performance curves
 - .4 Acoustical sound power data
 - .5 Dimensional layout and clearances
 - .6 Mounting arrangements
 - .7 Certification of compliance to applicable codes
 - .8 Operating and Maintenance information
 - .9 Wiring, single line and schematic diagrams (where applicable)

- .4 Clearly mark each sheet of printed submittal material, using arrow, underlining or circling, to show particular sizes, dimensions, wiring diagrams, operating clearances, control diagrams, project identification, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable material. Note on the submittal specified features such as special tank linings, pump seals, materials or painting.
 - .5 **Prior to submission to the Consultant, the Contractor shall review all shop drawings. By this review the Contractor represents that they have determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data or will do so and that they have checked and coordinated each shop drawing with the requirements of the Work and of the Contract Documents.**
 - .6 **The Contractor's review of each shop drawing shall be indicated by his approval stamp, date and signature on the front of each page. Drawings will not be considered if not previously checked by the Mechanical Contractor.**
 - .7 Review comments from the Consultant. If shop drawings are modified, confirm changes before proceeding. If shop drawings are not approved, revise and resubmit changes for approval within two (2) weeks.
 - .8 Review of the shop drawings by the Consultant does not relieve the Contractor or his Supplier of the responsibility to provide the correct and complete equipment, material or installation.
 - .9 Keep one complete set of shop drawings at the job site during construction.
 - .10 Include stamped reviewed shop drawings in the Maintenance Manuals.
- 1.9 Product Delivery Schedule
- .1 Within two (2) weeks from shop drawing review, a schedule must be submitted by the Contractor showing projected delivery dates of all products to meet required construction schedule.
- 1.10 Construction Meetings
- .1 The Mechanical Contractor shall attend all site meetings unless otherwise pre-approved.
 - .2 Sub-trades shall attend site meetings as requested or as required.
- 1.11 Record Drawings
- .1 Refer to Section 23 05 02.

- .2 Maintain accurate, neat, and clean record drawings on an **on-going basis** during construction to be reviewed periodically by the Consultant during construction.
- .3 Record drawing mark-ups shall be made available at every site meeting or inspection.
- .4 Record drawings shall include but not be limited to final location of any access doors on same for future service requirements.
- .5 Prior to Substantial Performance submit a complete set of record drawings in AutoCAD format. The Contractor is responsible for drafting all as-built conditions in AutoCAD. Any changes shall be drafted using layers, fonts, etc to match the original drawings. No new layers or fonts shall be used or created. The base electronic AutoCAD files will be made available from the Consultant. Make any changes as requested by the Consultant after review.

1.12 Reports

- .1 Provide the following reports upon completion of work by certified Contractors for review and approval by the Consultant:
 - .1 Equipment Start-Up Reports
 - .2 Balance Report (Air and Water)
 - .3 Gas Detection System Test Certificate
 - .4 Piping Pressure Test Reports (Gas, Hot Water Heating, Domestic)
 - .5 VFD Startup Report
 - .6 Chemical Treatment Test Report
 - .7 Backflow Preventer Test Reports
 - .8 Other equipment startup reports and test sheets certified by the manufacturer or a qualified technician
 - .9 Demonstration and Training Reports/Logs
- .2 All reports shall be dated and signed by the Technician who performed the start-up and/or tests.

1.13 Maintenance Manuals

- .1 Refer to Section 23 05 02.
- .2 Provide the Owner with two (2) **indexed**, hard cover maintenance manuals to local air balance industry standards plus one (1) electronic copy on labeled CD or on memory stick. Manuals shall contain and be tabbed in the following order:

- .1 Table of Contents
 - .2 Contractor's, Manufacturer's and Supplier's Contact Information
 - .3 Warranty Letter
 - .4 Valve schedule
 - .5 Colour coding charts for access areas
 - .6 Reports as specified herein and as applicable
 - .7 ALL stamped approved shop drawings – Include a tab and blank section for any Owner supplied equipment
 - .8 Equipment maintenance instructions and manuals
 - .9 Record drawings
 - .3 Submit one (1) complete copy to the Consultant for review and approval. Revise based on any comments and resubmit all copies and electronic copy to Consultant.
- 1.14 Testing and Startup
- .1 Refer to Sections 23 05 92 under this Division.
 - .2 Test and startup all equipment and work.
 - .3 Fully coordinate all testing and startups with all trades, the Consultant, and authorities having jurisdiction.
 - .4 **The Controls Contractor shall be present during all equipment start-ups. Coordinate scheduling with Controls Contractor.**
 - .5 Provide adequate notice to all parties.
- 1.15 Demonstration and Training
- .1 Demonstrate and train the Owner on proper operation of the system.
 - .2 Refer to Section 23 09 23 for additional training requirements for Controls.
 - .3 The Contractor shall arrange for all necessary personnel and equipment specialists to be in attendance for purposes of demonstration and training.
 - .4 Provide instruction by a manufacturer's representatives as required to fully demonstrate the systems.
 - .5 Demonstration and Training shall include but not be limited to:
 - .1 Training in the normal, abnormal and emergency operation of all systems provided under this Division.

- .2 Review of all necessary maintenance procedures, including winterization, of all systems provided under this Division.
- .3 Provision of a documented maintenance program covering all systems provided or modified under this contract.
- .4 Review of all close-out documentation including complete maintenance manuals and record drawings.
- .6 Prepare a Training Agenda and Log for signature by all Participants. Submit to Consultant and include in Manuals.

1.16 Substantial Completion and Performance

- .1 Substantial completion and performance shall be determined and awarded by the Consultant.
- .2 Complete the following to the satisfaction of the Consultant prior to request for substantial performance:
 - .1 Fire Dampers and Fire Stopping
 - .2 System Testing and Startups including report
 - .3 Balancing including report
 - .4 Maintenance Manuals
 - .5 Record Drawings
 - .6 Demonstration and Training

1.17 Warranty

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

2 Products

2.1 Materials

- .1 All material used shall be new, free from defects, of quality specified, and installed in accordance with manufacturer's instructions.
- .2 Major equipment shall have nameplates on the exterior of the equipment in a visible location containing manufacturer's name, model number, serial number, performance data, and electrical characteristics.
- .3 The same manufacturer shall be used for types of equipment used in

similar applications.

- .4 It is the responsibility of the Contractor to store and protect materials supplied by this scope.
- .5 Materials shall be stored in original containers.
- .6 Submit to the Consultant and the Owner, current M.S.D.S. Sheets for any products being used on the job site where they exist.
- .7 Remove and dispose of all redundant materials and garbage from site.
- .8 Supply anchor bolts and templates for installation by other Divisions.

2.2 Selected Products And Equivalentents

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

2.3 Quality of Product

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

2.4 Product Finishes

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

2.5 Access Doors

- .1 Provide access doors/panels as required for access, adjustment, operation, service, and maintenance.
- .2 Minimum size of panels shall be 12 inches by 18 inches (300 millimeters by 450 millimeters). Wherever possible 24 inches by 24 inches (600 millimeters by 600 millimeters) panels shall be used.
- .3 Access doors/panels shall have concealed hinges and screwdriver locking device.
- .4 ACCESS DOORS/COVERS - FLUSH ACCESS DOOR – DRYWALL AREA
 - .1 **Acudor DW-5040 Series** flush to surface for drywall, satin coat steel with white baked enamel finish, formed door panel, flanged on four sides, 20 gauge. Galvanized frame with multiple bends and integral taping bead, 26 gauge. Concealed hinge, stainless steel screwdriver operated cam latch.
- .5 ACCESS DOORS/COVERS - FLUSH ACCESS DOOR - UNIVERSAL
 - .1 **Acudor UF-5000** Universal Access Doors, 14 gauge (1.7 millimeters) steel, baked enamel prime coat, continuous concealed hinge, with positive and self-opening screwdriver operated lock.

2.6 Motors

- .1 Provide high efficiency motors for mechanical equipment as specified.
- .2 If delivery of specified motor will delay delivery or installation of any equipment, install a motor approved by Consultant for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- .3 Motors under 373 watt, (1/2 horsepower): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, voltage as indicated.
- .4 Motors 373 watt, (1/2 horsepower) and larger: E.E.M.A.C. Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees Celsius (72 degrees Fahrenheit), 3 phase, voltage as indicated.

2.7 Belt Drives

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
- .3 For motors under 7.5 kilowatt (10 horsepower): standard adjustable pitch drive sheaves, having plus or minus 10 percent range. Use mid-position of range for specified revolutions per minute.
- .4 For motors 7.5 kilowatt (10 horsepower and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .6 Motor slide rail adjustment plates to allow for centre line adjustment.
- .7 Provide sheave changes as required for final air balancing.

2.8 Guards

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives:
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 millimeters (18 gauge) thick sheet metal tops and bottoms.
 - .3 40 millimeters (1-1/2 inches) diameter holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 106 millimeters (16 gauge) thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.

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

2.9 Equipment Supports

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

2.10 Sleeves

- .1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated.
- .2 Schedule 40 steel pipe.
- .3 Sleeves with annular fin continuously welded at midpoint:
 - .1 Through foundation walls.
 - .2 Where sleeve extends above finished floor.
 - .3 Through fire rated walls and floors.
- .4 Sizes: minimum 6 millimeters (1/4 inch) clearance all around, between sleeve and un-insulated pipe or between sleeve and insulation.
- .5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25 millimeters (1 inch) above other floors.
- .6 Fill voids around pipes:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with water proof fire retardant non-hardening mastic. Refer to Section 22 05 01 for additional details regarding sealant required at below grade piping penetrations.
 - .2 Where sleeves pass through walls or floors, provide space for

- firestopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.
- .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
 - .4 Fill future-use sleeves with lime plaster or other easily removable filler.
 - .5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CGSB 1-GP-181M+Amdt-Mar-78.
 - .7 Provide minimum 20 gauge duct sleeves where ducts pass through masonry concrete or fire rated assemblies. Maintain minimum 25 millimeters clearance all around or to the requirements of the authority having jurisdiction. Seal at all as indicated.

2.11 Fire Stopping

- .1 This Contractor shall work with all other Contractors on the project in providing one common method of fire stopping all penetrations made in the fire rated assemblies.
- .2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.
- .3 Do not use cementitious or rigid seals around penetrations for pipe, ductwork, or other mechanical items.
- .4 Insulated pipes and ducts; ensure integrity of insulation and vapour barrier at fire separation.
- .5 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.
- .6 Comply with the requirements of C.A.N. 4-S115-M35, and do not exceed opening sized for which they have been tested.
- .7 Systems to have an F. or F.T. rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide "fire wrap" blanket around services penetrating fire walls. Extent of blanket must correspond to ULC recommendations.
- .8 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.
- .9 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.
- .10 Fire stop materials are to be capable of receiving finish materials in those

areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.

- .11 Firestopping shall be inspected and approved by local authority prior to concealment of enclosure.
- .12 Install material and components in accordance with U.L.C. certification, manufacturer's instructions and local authority.
- .13 Submit product literature and insulation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and Consultant.
- .14 Manufacturer of product shall provide certification of installation. Submit letter to the consultant.
- .15 Acceptable Manufacturers:
 - .1 Fryesleeve Industries Inc.
 - .2 General Electric Pensiil Firestop Systems
 - .3 International Protective Coatings Corp.
 - .4 Rectorseal Corporation (Metacaulk)
 - .5 Proset Systems
 - .6 3M
 - .7 A.D. Systems
 - .8 Hilti
- .16 Ensure firestop manufacturer representative performs on-site inspections and certifies installation. Submit inspection reports/certification at time of substantial completion.

2.12 Escutcheons

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

2.13 Spare Parts

- .1 Provide spare parts as specified under this Division.

- .2 Provide list of equipment in maintenance manuals indicating corresponding spare parts required. List of spare parts to be signed off by receiving personnel.

2.14 Special Tools

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

3 Execution

3.1 Site Examination

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

3.2 Interference and Coordination Drawings

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

3.3 Separation of Services

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

3.4 Workplace Safety

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

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

3.5 Temporary Requirements

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

3.6 Location of Equipment

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

3.7 Mounting Heights

- .1 Mounting height of equipment is from finished floor to equipment unless otherwise specified or indicated. Coordinate with block coursing if applicable.
- .2 Where mounting heights are not indicated on the drawings, obtain verification from the Consultant before proceeding.
- .3 Install mechanical equipment at the following heights unless otherwise indicated on the architectural drawings:
 - .1 Fire Extinguishers 1.5 meters (5 feet) to top of extinguisher (with or without cabinets)
 - .2 Backflow Preventers 900 to 1200 millimeters (3 feet to 4 feet) to centerline

3.8 Repairs, Cutting and Restoration

- .1 Patch and repair walls, floors, ceilings, and roofs with materials of same

quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.

- .2 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work and/or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
- .3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.
- .4 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

3.9 Painting

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

3.10 Concealment

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

3.11 Access Doors

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

3.12 Clearances and Accessibility

- .1 Install all work for easy access for adjustment, operation, service, and maintenance.
- .2 Maintain clearances for all equipment as per local codes and manufacturer's instructions.

- .3 Access panels shall be Acudor or equivalent with concealed hinges and screwdriver locking device.
- .4 Provide access panels of adequate size as required to access equipment and components in concealed areas. Do not install access doors in specialty walls or ceilings.
- .5 Provide fire rated access doors where installed in fire separations to match rating of separation.
- .6 Install all services in exposed areas so that a minimum head clearance of 2200 millimeters (88 inches) is maintained.

3.13 Equipment and System Protection

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

3.14 Supports

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

3.15 Fire Stopping

- .1 Refer to Part 2 herein.

3.16 Cleaning

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

3.17 Owner Supplied Equipment

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

3.18 Identification and Labeling

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

3.19 T.S.S.A Inspection

- .1 Prior to final completion of the project, this Contractor shall make application, arrange, and pay for a T.S.S.A. Inspection of all piping systems and equipment installations, including, but not limited to refrigeration, fuel piping, heating plant (boiler installation), and associated equipment installed under the contract.
- .2 Provide a copy of the T.S.S.A. Report in the maintenance manuals for each system.

3.20 Field Review and Deficiencies

- .1 The Contractor shall notify the Consultant when the job is ready for field review at various stages including rough-in stages.
- .2 During the course of construction, the Consultants will monitor construction and provide written reports of work progress, discussions and deficiencies.
- .3 The Contractor shall correct all deficiencies within the work period prior to the next review.
- .4 The Contractor shall not conceal any work until inspected. Where work was concealed, the Contractor shall remove and replace tiles, coverings or other obstructions to allow proper inspection at the Contractor's expense.
- .5 Upon completion of the project the Consultant will do a final review. Upon receiving the final inspection report, the Contractor must correct and sign back the inspection report indicated all deficiencies are completed. A re-inspection will only be done once the Consultant receives this in writing. Where the Consultant performs the re-inspection and the work is not complete, the Contractor is responsible for reimbursing the Consultant for the field review. The fee for additional reviews will be at the Consultant's hourly rates plus mileage and applicable taxes to be paid directly to the Consultant prior to performing the next field review.

End of Section

- 1 General
 - 1.1 Work Included
 - .1 Operating and Maintenance Manuals
 - .2 Assembly of equipment details sheets and shop drawings including Owner supplied equipment
 - .3 Assembly of equipment and systems operating and maintenance instructions
 - .4 Assembly of equipment start up and performance tests and reports
 - .5 Assembly of Balancing Report
 - .6 Assembly of final inspection certificates
 - .7 As Built Drawings
 - 1.2 Related Work
 - .1 Division 1
 - .2 General Mechanical Requirements – Section 22 05 01 and 23 05 01.
- 2 Products
 - 2.1 Operation and Maintenance Materials
 - .1 Provide two (2) 8½ inches by 11 inches, 3 ring type catalogue binders, labeled front and spine, with plastic tab dividers and Table of Contents. Also provide one (1) complete manual in electronic PDF format on memory stick.
 - .2 Manufacturer's data section is to be indexed and ordered to exactly match the sections of the specifications. Each section of the manufacturer's data section is to include an up to date copy of the equipment schedule for that section. The schedule is to be revised to suit all addenda, change orders and field changes, as well as manufacturers and model numbers matching the equipment supplied.
 - .3 Assemble or develop complete and correct documentation for the operation and maintenance information for equipment and systems provided.
 - .4 Assemble or develop copies of all certified shop drawings and material required to complete the documentation. This generally includes but is not limited to the following:
 - .1 Table of Contents
 - .2 Contractor's, Manufacturer's and Supplier's Contact Information

- .3 Warranty Letter
- .4 Valve schedule
- .5 Colour coding charts for access areas
- .6 Reports:
 - .1 Equipment Start-Up Reports
 - .2 Balance Report (Air and Water)
 - .3 Gas Detection System Test Certificate
 - .4 Piping Pressure Test Reports (Gas, Hydronic, Refrigeration)
 - .5 VFD Startup Report
 - .6 Chemical Treatment Test Report
 - .7 Backflow Preventer Test Report
 - .8 Other equipment startup reports and test sheets certified by the manufacturer or a qualified technician
 - .9 Demonstration and Training Reports/Logs
- .7 ALL stamped approved shop drawings – Include a tab and blank section for any Owner supplied equipment
- .8 Maintenance instructions, requirements and schedule
- .9 As Built Drawings

2.2 As Built Drawings

- .1 As Built Drawings shall be kept up-to-date on an ongoing basis during construction for periodic review by the Consultant. As Built drawings shall always be kept in the same location on site known to the Consultant.
- .2 Contractors shall certify that final reproducible As Built drawings to be correct by notation and signature on the drawings.
- .3 As Built Drawings shall precisely identify the configuration, size and location of all systems and equipment installed under this Division, including but not limited to:
 - .1 Heating: shut off valves, balancing valves, piping, access doors.
 - .2 Controls: controllers, panels, devices, relay cabinets, sensors, thermostats, valve operators, wiring and conduit runs complete with legend.

- .3 Miscellaneous: actual room names and numbers, schematic diagrams, riser diagrams.
 - .4 As Built Drawings must be submitted to consultant as specified herein.
- 2.3 Balance Reports
 - .1 Refer to Section 23 05 93 – Balancing.
 - .2 Include a copy of Balance Report in Operating and Maintenance Manuals including duct leakage tests.
- 2.4 Test and Start-Up Reports
 - .1 Refer to section 23 05 92 – Testing, and Section 23 05 01 – General Mechanical Requirements.
 - .2 Include a copy of all test and start-up reports in Operating and Maintenance Manuals.
 - .3 Obtain final copies of any 3rd Party test reports for inclusion in Operating and Maintenance Manuals.
- 2.5 Demonstration and Training Reports
 - .1 Refer to Section 23 05 01 – General Mechanical Requirements
 - .2 Include a copy of all Training literature in the Operating and Maintenance Manuals.
 - .3 Include a copy of the signed and dated Training Log.
- 3 Execution
 - 3.1 General
 - .1 A hard copy of the maintenance manual shall be provided immediately upon completion of startup and testing for review and for use during the Demonstration and Training. The Manual shall include all test and start-up reports. Substantial Completion will not be awarded until the manual is submitted and accepted.
 - .2 The Consultant will review the manual and provide any comments or changes required. The Contractor shall revise and finalize all manuals within three (3) weeks.
 - .3 Substantial Performance will not be granted until the final hard copies and electronic copy of the complete manual have been submitted by the Contractor and reviewed and accepted by the Consultant.
 - .4 Submit a draft copy of the manual to the Consultant for review prior to final submission of all copies.

- .5 Provide two (2) final hard copies and one (1) electronic copy in P.D.F. format to the Consultant for final acceptance.

3.2 As Built Drawings

- .1 Prior to Substantial Performance submit a complete set of As Built drawings in pdf format. The files will be made available to the Consultant for review and drafting in AutoCAD. Make any changes as requested by the Consultant after review.
- .2 Substantial performance will not be granted until the As Built drawings have been submitted to the Consultant.

End of Section

- 1 General
 - 1.1 Work Included
 - .1 Pressure gauges and pressure gauge taps
 - .2 Thermometers and thermometer wells
 - .3 Combination instrumentation taps and gauges
 - 1.2 Submittals
 - .1 Refer to Section 23 05 01.
 - .2 Submit shop drawings for gauges and thermometers complete with a list which indicates use, operating range, and suitable range of each.
- 2 Products
 - 2.1 General
 - .1 All gauges and thermometers shall be calibrated and shall display in either/both metric and imperial units.
 - 2.2 Acceptable Manufacturers
 - .1 Weiss
 - .2 Winters
 - .3 Terrice
 - 2.3 Pressure Gauges
 - .1 Steel case, liquid filled, 100 millimeters (4 inches) diameter, phosphor bronze bourdon tube brass movement, extruded brass socket, accurate to 1.5 percent.
 - 2.4 Pressure Gauge Taps
 - .1 Provide brass needle or gate valve.
 - 2.5 Digital Thermometers
 - .1 Thermometers shall be equal to Weiss Instruments solar digital vari-angle type, model DVU35 complete with CWE35-75BS well.
 - .1 Case: Hi-impact ABS
 - .2 Range (with F/C switch): minus 50/300 degrees Fahrenheit (minus 40/450 degrees Celsius)
 - .3 Display: ½ inch L.C.D. digits, wide ambient formula
 - .4 Accuracy: 1 percent of reading or 1 degree whichever is greater

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- .5 Resolution: 1/10 degrees between minus 19.9/199.9 degrees Fahrenheit (minus 28/93 degrees Celsius)
 - .6 Recalibration: Through case potentiometer adjustment
 - .7 Lux Rating: 10 Lux (one foot-candle)
 - .8 Update: 10 seconds
 - .9 Ambient Operating: minus 30/140 degrees Fahrenheit (minus 35/60 degrees Celsius)
 - .10 Ambient Temp Error: 0
 - .11 Humidity: 100 percent
 - .12 Sensor: Glass passivated thermistor – N.T.C.
 - .13 Stem Assemblies: Industrial glass full conformance with Fed Spec GG-T-321D. Fully interchangeable with Industrial Glass Thermometers.
- .2 Thermowells shall be brass separable socket, $\frac{3}{4}$ inch N.P.T., complete with gasket and cap, size as required.
 - .3 Provide tilt adjustment to view without climbing from floor.
- 2.6 Stem Type Thermometers
- .1 11 inches long, adjustable scale, red indicator, brass separable socket.
 - .2 Well: Brass separable socket complete with gasket and cap, size as required.
 - .3 Provide tilt adjustment on devices if required to view without climbing from floor.
- 2.7 Sensor Wells
- .1 Sensor wells shall be supplied by the Controls Contractor and turned over to the Heating Contractor under this Section for installation.
- 3 Execution
- 3.1 Pressure Gauges
- .1 Install where indicated on drawings complete with ball valve.
 - .2 Provide only one pressure gauge per pump. Install common header, $\frac{1}{2}$ inch diameter pipe, complete with four control ball valves to allow selection of pressure reading from each of the following points. Refer to schematic diagram.
 - .1 before strainers

- .2 on pump suction
- .3 on pump discharge
- .4 on check valve discharge if so equipped

3.2 Pressure Gauge Taps:

- .1 Both sides of two-way control valves
- .2 All lines to three-way control valves
- .3 All lines to control valves 25 mm and larger
- .4 As shown on drawings.

3.3 Thermometers

- .1 Install digital type unless otherwise indicated.
- .2 Install thermometers so they can be easily read from floor level. If this cannot be accomplished, install remote reading units.
- .3 Install in locations allowing ease of accurate observation without obstruction, light glare or danger to the reading technicians.
- .4 Provide tilt adjustment on devices to view without climbing from floor.
- .5 Thermometers are to be installed in thermowells so that they can be replaced without draining the system.

3.4 Sensor Wells

- .1 Sensor wells shall be supplied by the Controls Contractor and turned over to the Heating Contractor under this Section for installation

End of Section

- 1 General
 - 1.1 Manufacturer
 - .1 Provide valves of same manufacturer throughout where possible.
 - .2 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.
 - 1.2 Quality Assurance
 - .1 Valves for gas service shall be trimmed and approved for specified service.
 - .2 All valves shall meet all MSS, ANSI and ASME manufacturing standards.
 - 1.3 Submittals
 - .1 Refer to Section 23 05 01 – HVAC General Requirements.
 - .2 Manufacturer's data and shop drawings for all valves and accessories including dimensions, pressure ratings, materials, service acceptability.
- 2 Products
 - 2.1 General
 - .1 All valves must be of threaded or flanged type.
 - .2 Valves 300 millimeters (12 inches) and larger located with stem in the horizontal position shall be drilled and taped to accommodate a drain valve and equalizing bypass valve assembly.
 - .3 No yellow brass valves will be allowed.
 - .4 Wafer style valves (except check valves) are not allowed.
 - 2.2 Valve Connections
 - .1 Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.
 - .2 Thread pipe sizes 50 millimeters (2 inches) and smaller.
 - .3 Flange pipe sizes 63 millimeters (2½ inches) and larger.
 - .4 Solder or screw to solder adaptors for copper piping.
 - .5 Use grooved body valves with mechanical grooved jointed piping where approved only.
 - .6 Provide butterfly valves with tapped lug body when used for isolating service.
 - 2.3 Check Valves

- .1 Bronze, swing disc, solder or screwed ends.
- .2 Iron body, bronze trim, swing disc, renewable disc and seat, flanged ends.
- .3 Iron body, bronze trim, spring loaded, renewable composition disc, flanged ends.
- .4 Acceptable Models:
 - .1 Jenkins 587J
 - .2 NH T651
 - .3 Kitz 78
 - .4 Red & White (Toyo) 435
- .5 Grooved end (where approved), working pressure to 300 p.s.i. (2065 kilopascals): Sizes 2 to 4 inches – Ductile iron body and 316 stainless steel clapper. EPDM, Nitrile or optional Viton Bumper and Bonnet seals. Stainless steel wetted parts. Manufacturer: Victaulic Series 716; Sizes 4 to 14 inches – Ductile iron disc, elastomer encapsulated suited for the intended service, stainless steel spring and shaft, welded-in nickel seat. Valve inlet is drilled, with venturi-like taps and plugged for flow kit (included with valve). Twin taps on both sides of valve for meter connections and flow measurement. Manufacturer: Victaulic Series 779.

2.4 Butterfly Valves

- .1 Iron body, lug pattern, bronze or stainless steel disc, resilient replaceable EPDM liner seat, plain flanged or grooved ends.
- .2 Acceptable Models:
 - .1 Jenkins 2232ELJ (Lever) 2232EGJ (Gear)
 - .2 N.H. 45-313321 (Lever) 45-313322 (Gear)
 - .3 Kitz 6122-EL (Lever) 6122-EG (Gear)
 - .4 Kitz 6141-EL (Lever) 6141-EG (Gear)
 - .5 Red and White (Toyo) 918BESL (Lever) 918-BESG (Gear)
 - .6 Crane Model 44
- .3 Grooved end (where approved): 2.5 inches and larger where grooved end piping systems are allowed, shall be rated to 300 psi and be both bi-directional and dead-end service capable to full rated pressure. Body material shall be ductile iron with blow-out proof stainless steel stems and electroless nickel coated ductile iron disc. Seat material shall be EPDM (or lubricated nitrile or fluoroelastomer) and have a full 360 degrees continuous contact with the seating surface. Stem seals shall be of the

same material grade as the seats. Disc shall be offset from the centerline of the stems and shall be connected to the stem without the use of fasteners or pins. Acceptable manufacturers: Victaulic Vic-300 MasterSeal, Vic-300 A.G.S.

2.5 Control Valves

- .1 Refer to Section 23 09 23.
- .2 Control valves to be supplied by the Controls Contractor and turned over to the H.V.A.C. Contractor for installation.

2.6 Ball Valves

- .1 Up to 38 millimeters (1½ inch): Forged bronze body, delrin seat and seals, chrome plated ball, forged steel pin, screwed ends, 1206 kilopascals (175 p.s.i.). Acceptable material: Victaulic Series 722.
- .2 Tail piece supply isolation valves: ball type valves, angle configuration, screw driver operated, compression fittings or threaded as required, chrome plated if exposed.
- .3 Acceptable Models:
 - .1 Jenkins
 - .2 NH
 - .3 Kitz 58 and 59
 - .4 Red and White (Toyo) 5044A and 5049A
 - .5 M.A.S. B3 and B4

2.7 Gate Valves

- .1 Bronze, inside screw, double wedge or disc, solder or screwed ends.
- .2 Over 100 millimeters (4 inches): Iron body, bronze trim, rising stem, OS&Y solid wedge, flanged ends.
- .3 Acceptable Models:
 - .1 Jenkins 454J
 - .2 NH T504
 - .3 Kitz 72
 - .4 Red & White (Toyo) 421

2.8 Globe or Angle Valves

- .1 Bronze, renewable composition disc, solder or screwed ends.

- .2 Over 100 millimeters (4 inches): Iron body, bronze trim, rising stem, OS&Y, renewable composition disc, flanged ends.
- .3 Acceptable Models:
 - .1 Jenkins 2342J
 - .2 N.H. T731
 - .3 Kitz 726
 - .4 Red and White (Toyo) #00
- 2.9 Circuit Balancing Valves (C.B.V.)
 - .1 Valves shall be Y-pattern globe style design with provision for connecting a portable differential (ft. of head) pressure meter.
 - .2 Valves shall have all metal parts of nonferrous, pressure die cast, nonporous Ametal.
 - .3 The valves shall be suitable for the following functions:
 - .1 Precise flow measurement
 - .2 Precise flow balancing
 - .3 Positive shut-off with no drip seat eliminating the need of an additional isolation valve.
 - .4 Drain connection using $\frac{3}{4}$ inch N.P.T. hose end thread.
 - .4 Valves shall have four (4) 360 degree adjustment turns of the handwheel for precise setting with hidden memory to provide a temper-proof balancing setting. Handwheel shall have digital readout. The handwheel can be installed in any position without affecting performance.
 - .5 For sizes $\frac{1}{2}$ inch to 2 inches:
 - .1 300 P.S.I., Y-pattern, globe type with soldered or threaded ends, non-ferrous Ametal brass copper alloy body, E.P.D.M. o-ring seals.
 - .2 4-turn digital readout handwheel for balancing, hidden memory feature with locking tamper-proof setting, and connections to portable differential meter.
 - .3 Acceptable Manufacturer: IMI Hydronic Series 786 S.T.A.S. (solder), 787 S.T.A.D. (threaded) or 78K (MxF) or Armstrong equal.
 - .6 For sizes $2\frac{1}{2}$ inches to 12 inches:

- .1 300 P.S.I., Y-pattern, globe type with flanged or grooved ends, A.S.T.M. A536 ductile iron body, all other parts of Ametal brass copper alloy, E.P.D.M. o-ring seals.
- .2 8, 12, 16, 20 or 22 turn digital readout handwheel for balancing, hidden memory feature with locking tamper-proof setting, and connections to portable differential meter.
- .3 Acceptable Manufacturer: IMI Hydronic Series 788 S.T.A.F (flanged) or 789 S.T.A.G. (grooved) or Armstrong equal.
- .7 Acceptable Manufacturers
 - .1 IMI Hydronics
- .8 Circuit Balancing Valve sizing (schedule based on IMI):

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

2.10 Pressure Reducing Valves – Water

- .1 Listed to A.S.S.E. 1003 and I.A.P.M.O. and certified to C.S.A. B356.
- .2 Low Pressure (Boiler Make-Up Water)
 - .1 Adjustable Reduced Pressure Range: 10 to 35 p.s.i.
 - .2 Maximum Working Pressure: 200 p.s.i. (14 bar)
 - .3 N.P.T. Threaded female union inlet by N.P.T. female outlet
 - .4 Bronze body construction

- .5 Stainless Steel Integral strainer
- .6 High temperature resistant diaphragm
- .7 Renewable stainless steel seat
- .8 Serviceable in-line
- .9 Sealed spring cage, corrosion-resistant adjusting and cage screws for waterworks pit installations
- .10 Equal to U5B-LP
- .3 High Pressure
 - .1 Pressure reduced from as high as 300 p.s.i. (20.7 bar) to 50 p.s.i. (345 kilopascals) or lower
 - .2 Sealed spring cage and stainless steel corrosion resistant adjusting cage screws for accessible outdoor or pit installations
 - .3 Integral stainless steel strainer
 - .4 Replaceable seat module
 - .5 Bronze body construction
 - .6 Serviceable in line
 - .7 Bypass feature controls thermal expansion pressure
 - .8 High temperature resistant reinforced diaphragm for hot water
 - .9 Equal to Watts U5B-Z3
- .4 Less than 100 millimeters (4 inches): Bronze body, brass bonnet, composition rubber diaphragm, plated or stainless steel spring, internal strainer.
- .5 100 millimeters (4 inches) and over: High tensile cast iron body and bonnet, seat, composition disc and diaphragm, bronze needle control pilot valve with small pressure regulating valve. Flanged body and bonnet.
- 2.11 Vacuum Breakers – Water
 - .1 Bronze body, brass trim, composition silicone float disc, full size orifice.
- 2.12 Relief Valves
 - .1 Provide A.S.M.E. rated direct spring loaded type, lever operated nonadjustable factory set discharge pressure as indicated.
- 2.13 Drain Valves
 - .1 Bronze compression stop with $\frac{3}{4}$ inch hose threaded.

- .2 Brass ball valve with ¾ inch hose thread.
- .3 Provide hose thread connection on valve or piping.
- .4 Equal to 868C (LEAD FREE), KITZ 68AC (NON LEAD FREE)

2.14 Double Check Valve Assembly - Reduced Pressure Type

- .1 Bronze or red brass body, stainless steel springs, composition diaphragm.
- .2 Independent acting spring loaded double internal disc valve, three chamber, discharge to atmosphere.
- .3 Acceptable Models:
 - .1 Watts 009 QT
 - .2 Zurn 975 XL
 - .3 Febco 825 Y
 - .4 Combraco 40-200
- .4 Non-electronic testing apparatus including gauge, hoses, fittings, accessories, and case. Maximum temperature 104.4 degrees Celsius (220 degrees Fahrenheit), maximum pressure 1034 kilopascals (150 p.s.i.). Equal to Watts TK-9A.

2.15 Strainers

- .1 Strainers 50 millimeters (2 inches) and smaller shall be constructed for 250 p.s.i.g. operating pressure at 406 degrees Fahrenheit and shall have a cast iron threaded body and 20 mesh Type 304 stainless steel screen.
- .2 Strainers larger than 50 millimeters (2 inches) shall be constructed for 125 p.s.i.g. at 150 degrees Fahrenheit and shall have a cast iron flanged body and a 3/64 inch perforated Type 304 stainless steel screen up to 75 millimeters (3 inches) and a 1/8 inch perforated Type 304 stainless steel screen on 100 millimeters (4 inches) and larger.
- .3 Screen free area shall be minimum three times area of inlet pipe. Provide valved drain and hose connection off strainer bottom.
- .4 Strainers 50 millimeters (2 inches) and smaller shall have straight thread and gasketed caps and plugged blow-off connections.
- .5 Strainers larger than 50 millimeters (2 inches) shall include drain connections complete with ball valve, cap and chain.
- .6 Grooved end (where approved): 50 millimeters (2 inches) and larger, 300 P.S.I. (2065 kilopascals) Y-Type Strainer shall consist of ductile iron body, ASTM A-536, Grade 65-45-12, Type 304 stainless steel perforated metal removable baskets with 1/16 inch (1,6 millimeters) diameter perforations 2

inches-3 inches (DN50-DN75) strainer sizes, 1/8 inch (3,2 millimeters) diameter perforations 4 inches- 12 inches (DN100-DN300) strainer sizes, and 0.156 inch (4 millimeters) diameter perforations for larger sizes. Victaulic Style 732 and W732.

2.16 Pressure Ratings

- .1 Unless otherwise indicated, use valves suitable for minimum 860 kilopascals (125 p.s.i.) and 232 degrees Celsius (450 degrees Fahrenheit).
- .2 Use valves for fire protection suitable for 1206 kilopascals (175 p.s.i.).

2.17 Manual Valve Operators

- .1 Provide suitable handwheels for gate, globe or angle, radiation and drain valves.
- .2 Provide one plug cock wrench for every plug cock valve.
- .3 Butterfly Valves: Provide lever lock handle with toothed plate for shutoff service.
- .4 Provide valves sized 4 inches and larger located more than 8 feet from floor in equipment room areas with chain operated sheaves. Extend chains to approximately 60 inches above floor and hook to clips arranged to clear walking aisles.

3 Execution

3.1 General

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

3.2 Application

- .1 Use ball valves for gas service. Plug cocks are not to be used for gas isolation service.

- .2 Use ball valves on pressure gauges.
- .3 Use plug cocks, globe valves, ball valves, butterfly valves, and metering valves in water systems for throttling service.

3.3 Isolation Valves

- .1 Isolation valves are to be ball type valves, pipe size as required, but in no case less than 13 millimeters ($\frac{1}{2}$ inch) diameter.
- .2 For equipment removal purposes, isolation valves are to be installed with companion screwed unions on piping less than 75 millimeters (3 inches) diameter, or flanged connections on piping 75 millimeters (3 inches) and larger. Grooved mechanical couplings may be used for equipment removal, subject to accessibility, suitability and where approved by specification terms for that piping system or equipment.
- .3 Install valves as close as possible to isolated equipment in order to minimize the amount of water lost during maintenance, replacement or drain down operations.
- .4 Isolation drain valves are to be provided with combination air inlet fitting as required to relieve vacuum during draining operations.
- .5 Install gate valves or ball valves where approved for shutoff and isolating service, or to isolate equipment, parts of systems or vertical risers.
- .6 Provide drain valves at main shutoff valves, low points of piping and equipment.

3.4 Control Valves

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

3.5 Circuit Balancing Valves (C.B.V.)

- .1 The Contractor shall size and install balancing valves according to design flow.
- .2 Install C.B.V.'s in accordance with manufacturer's instructions.
- .3 Use flanged type for $2\frac{1}{2}$ inches and over in areas where welded pipe is to be used.

- .4 Valves shall be installed with flow in the direction of the arrow on the valve body.
 - .5 Five pipe diameters upstream of the C.B.V. shall be free from any fittings..
 - .6 Two pipe diameters downstream of the C.B.V. shall be free from any fittings.
 - .7 Install such that easy and unobstructed access to the valve handwheel and metering port for adjustment and measurement is provided. Handwheel shall be in the horizontal 90 degree position.
 - .8 Mounting in valve in piping must prevent sediment build-up in metering ports.
 - .9 Mark up set of as-built drawings indicating balanced flow value and C.B.V. setting.
 - .10 Label ceiling grid at all C.B.V.'s concealed above ceilings.
- 3.6 Pressure Reducing Valve
- .1 Install as per manufacturer's recommendations.
 - .2 Install in vertical position only.
- 3.7 Relief Valves
- .1 Provide relief valves at pressure tanks, low pressure side of reducing valves, heating convertors, expansion tanks and where indicated.
 - .2 Pipe relief valve to nearest floor drain.
 - .3 System relief valve capacity shall equal make up pressure reducing valve capacity. Equipment relief valve capacity shall exceed input rating of connected equipment.
 - .4 Where one line vents several relief valves, cross sectional area shall equal sum of individual vent areas.
- 3.8 Drain Valves
- .1 Provide ball valves for drains on open systems.
 - .2 Provide unions downstream of the valve to allow breaking the piping system.
 - .3 Provide hose thread connection on drain valve and piping.
- 3.9 Double Check Valve Assembly

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

3.10 Strainers

- .1 Install on the inlet of all pumps.
- .2 Install on the inlet of all coils.

End of Section

- 1 General
 - 1.1 Quality Assurance
 - .1 Hydronic water pipe supports shall meet the requirements of A.N.S.I. B31.
 - .2 Natural gas pipe supports shall meet the requirements of C.G.A. B149.1, Gas Installation Code.
 - .3 Duct hangers shall follow the recommendations of the S.M.A.C.N.A. Duct Manuals.
 - 1.2 General Requirements
 - .1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade and provide for expansion and contraction.
 - .2 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.
 - .3 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
 - .4 Obtain approval prior to drilling for inserts and supports for piping systems.
 - .5 Obtain approval prior to using percussion type fastenings.
 - .6 Use of other piping or equipment for hangers and supports is not permitted.
 - .7 Use of perforated band iron, wire or chain as hangers is not permitted.
 - 1.3 Firestop Sealants and Collars
 - .1 Standard method of fire tests of firestop system C.A.N. 4-S115-M85.
 - .2 UL Classified and/or F.M. Systems Approved and tested to the requirements of A.S.T.M. E814 (U.L.1479).
 - .3 Seals, assemblies and materials for penetration of fire rated surfaces shall be listed by F.M. and certified by U.L. or U.L.C. for the service application.
 - 1.4 Submittals
 - .1 Firestop materials: Submit service limitations, installation instructions, U.L. certification and FM listing.
 - .2 Fire rated penetration seals: Submit dimensional data, service limitations, installation instructions, U.L. certification and F.M. listing.

2 Products

2.1 Inserts

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

2.2 Suspended Mechanical Equipment:

- .1 Suspend mechanical equipment from structure with adjustable length steel rods, threaded both ends or continuous threaded, complete with lock nuts on both ends. Provide spreader beams to distribute weight.
- .2 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- .3 Provide anchors, bolts and accessories required for mounting and anchoring equipment.

2.3 Pipe Hangers and Supports

- .1 **Pipe hangers shall wrap around outside of insulation for all sizes.** Piping shall be provided with insulation flashing of heavy gauge metal to prevent crushing and hanger sized for exterior of insulation.
- .2 Hangers:
 - .1 Pipe Sizes 13 millimeters ($\frac{1}{2}$ inch to 38 millimeters ($1\frac{1}{2}$ inches): Adjustable wrought steel ring, or plated strap.
 - .2 Pipe Sizes 50 millimeters (2 inches) and over: Adjustable wrought steel clevis.
 - .3 Hanger Rods: Provide steel hanger rods, threaded both ends or continuous threaded, complete with lock nuts on both ends.
 - .4 Saddles shall wrap around the outside of the insulation for all piping and be sized accordingly.
- .3 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods, cast iron roll and stand for hot pipe sizes 150 millimeters (6 inches) and over.
- .4 Wall Support:
 - .1 Pipe Sizes to 75 millimeters (3 inches): Cast iron hook, or fabricated bracket of 1 inch by 1 inch by $\frac{1}{4}$ inch angle bar.
 - .2 Pipe Sizes 100 millimeters (4 inches) and over: Welded steel bracket and wrought steel clamp.

- .5 Vertical Support:
 - .1 Steel riser clamp.
- .6 Floor Support:
 - .1 Fabricated stand and pipe clamp or saddle.

2.4 Natural Gas Piping Roof Supports

- .1 Gas pipe support systems shall be continuous block channel supports equal to "DURA-BLOK" DB-Series or DB6-Series as supplied by Cooper B-Line, Incorporated.
- .2 Alternate products must meet or exceed the same physical and performance characteristics as per the following:
 - .1 Density: 0.52 ounces per cubic unit in A.S.T.M. C642
 - .2 Durometer Hardness: 67.2A \pm 1 A.S.T.M. D2240
 - .3 Tensile Strength: 231 p.s.i. minimum A.S.T.M. D412
 - .4 Compression Deformation: 5 percent at 70 p.s.i. and 72 degrees Fahrenheit A.S.T.M. D395
 - .5 Brittleness at Low Temp: minus 50 degrees Fahrenheit A.S.T.M. D746
 - .6 Freeze and thaw when exposed to deicing chemicals: No loss after 50 cycles A.S.T.M. C672
 - .7 Coefficient of Thermal Expansion: 8 by 10⁻⁶ inches per inches per degrees Fahrenheit (minimum) A.S.T.M. C531
 - .8 Weathering: 70 hours at 120 degrees Fahrenheit A.S.T.M. D573
 - .9 Hardness retained: 100 percent (\pm 5 percent)
 - .10 Compressive strength: 100 percent (\pm 5 percent)
 - .11 Tensile strength: 100 percent (\pm 5 percent)
 - .12 Elongation retained: 100 percent (\pm 5 percent)
- .3 Curb base shall be made of 100 percent recycled rubber and polyurethane prepolymer with a uniform load capacity of 500 pounds per linear foot of support. Each base to have a reflective yellow stripe.
- .4 Dimensions: 6-inches wide by 5/6.75 inches tall by 9.6/20.2/30.8/41.4/52.0 inches long to suit pipe size.
- .5 Steel frame: Steel, 14 gauge strut galvanized per A.S.T.M.A653 or 12 gauge strut galvanized per A.S.T.M.A653 for bridge series.

- .6 Attaching hardware: Zinc-plated threaded rod, nuts and attaching hardware per A.S.T.M. B633.

2.5 Duct Hangers and Supports

.1 Hangers:

- .1 Concealed - Round Duct: Galvanized steel band iron.
 - .2 Concealed - Rectangular Duct: Galvanized steel band iron or rolled angle and 9 millimeters rods.
 - .3 Exposed - Round Duct: continuous galvanized steel band iron secured to single 9 millimeters hanger rod.
- .2 Wall Supports: Galvanized steel band iron or fabricated angle brackets.
 - .3 Vertical Support at Floor: Rolled angle.
 - .4 Support rectangular ducts 1530 millimeters and less in width or depth with 25 millimeters wide 1.3 millimeters or heavier galvanized bent hangers fastened to the side and bottom of the duct at a spacing of not greater than 2240 millimeters using bolts, rivets, or metal screws.
 - .5 Support duct over 1530 millimeters in width or depth with 10 millimeters vertical hanger rods, bolted to galvanized steel angles at 610 millimeters intervals.
 - .6 Support round ducts up to 910 millimeters with 25 millimeters wide, 1.0 millimeters thick single galvanized steel traps and 9 millimeters diameter rods. Support larger ducts with 25 millimeters wide, 1.6 millimeters thick double, horizontally split galvanized steel strap and two (2) 9 millimeters diameter rods. Space support at 3600 millimeters intervals.
 - .7 Where vertical ducts pass through floors, support with galvanized steel angles riveted and/or bolted to the cut and bearing on the structure.

2.6 Equipment Bases and Curbs

- .1 Equipment bases and curbs shall be provided by the General Contractor. The Mechanical Contractor shall coordinate locations and sizes with the General Contractor.
- .2 Provide mounting plates to be formed into pads.

3 Execution

3.1 Inserts

- .1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

- .2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 100 millimeters (4 inches) or ducts over 1500 millimeters (60 inches) wide.
- .3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
- .4 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.
- .5 Expansion bolt type connections will be approved under certain conditions. Obtain approval from the Consultant. Generally, pipe 50 millimeters (2 inches) or smaller, and ducts less than 600 millimeters x 300 millimeters (24 inches x 12 inches) will be approved, subject to adequate number of support points.

3.2 Suspended Mechanical Equipment:

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

3.3 Pipe Hangers and Support

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

<u>Nominal Pipe Size</u>	<u>Distance Between Supports</u>	<u>Hanger Rod Diameter</u>
13 millimeters (½ inches)	1.8 meters (6 feet)	9.5 millimeters (3/8 inch)
19 to 38 millimeters (¾ inch to 1½ inches)	2.4 meters (8 feet)	9.5 millimeters (3/8 inch)
50 to 63 millimeters (2 inches to 2½ inches)	3.0 meters (10 feet)	9.5 millimeters (3/8 inch)

63 to 100 millimeters (3 inches to 4 inches)	3.6m (12 feet)	13 millimeters (½ inch)
150 to 300 millimeters (6 inches to 12 inches)	4.3 meters (14 feet)	13 millimeters (½ inch)
350 to 450 millimeters (14 inches to 18 inches)	5.0 meters (16 feet)	25 millimeters (1 inch)

- .3 Install hangers to provide minimum 32 millimeters (1¼ inches) clear space between finished covering and adjacent work.
- .4 Place a hanger within 300 millimeters (12 inches) of each horizontal elbow.
- .5 Use hangers which are vertically adjustable 38 millimeters (1½ inches) minimum after piping is erected.
- .6 Support vertical piping at every floor.
- .7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .8 Where practical, support riser piping independently of connected horizontal piping.
- .9 Exposed piping, with less than 2.6 meters (8½ feet) clearance to floors shall be provided with two times the number of hangers normally required. Spacing shall be equal or adjusted for maximum benefit.
- .10 Provide copper plated hangers and supports for copper piping or provide nonferrous packing between hanger or support and piping.
- .11 Large capacity piping with vibration potential shall not be suspended from any building structure that will allow transfer of vibrations to the occupied spaces.

3.4 Natural Gas Piping Roof Supports

- .1 Install in accordance with manufacturer's instructions and recommendations.
- .2 If gravel top roof, gravel must be removed around and under pipe support.
- .3 Where possible, consult roofing manufacturer for roof membrane compression capacities. If necessary, a compatible sheet of roofing material (rubber pad) may be installed under rooftop support to disperse concentrated loads and add further membrane protection.
- .4 Space in conformance with Gas Code and local authorities.

- .5 Use properly sized clamps to suit pipe sizes.

3.5 Duct Hangers and Supports

.1 Hanger minimum sizes:

- .1 Up to 750 millimeters (30 inches) wide or 330 millimeters (13 inches) diameter: 1¼ inches by 16 gauge at 3 meters (10 feet) spacing.
- .2 750 millimeters (30 inches) to 1200 millimeters (48 inches) wide or up to 450 millimeters (18 inches) diameter: 1½ inches by 16 gauge at 3 meters (10 feet) spacing.
- .3 Over 1200 millimeters (48 inches) wide: 1½ inches by 16 gauge at 3 meters (10 feet) spacing.

.2 Horizontal duct on wall supports minimum sizes:

- .1 Up to 450 millimeters (18 inches) wide: 1½ inches by 16 gauge or 1 inch by 1 inch by 1/8 inch at 3 meters (10 feet) spacing.
- .2 450 millimeters (18 inches) to 1000 millimeters (40 inches) wide: 1½ inches by 1½ inches by 2 inches at 1.8 meters (6 feet) spacing.

.3 Vertical duct on wall supports minimum sizes:

.1 Riveted or screwed to duct:

- .1 Up to 1500 millimeters (60 inches) wide: 1½ inches by 1½ inches by 3 inches
- .2 Over 1500 millimeters (60 inches) wide: 2 inches by 1/8 inch

.4 Vertical duct floor supports minimum sizes:

.1 Riveted or screwed to duct:

- .1 Up to 1500 millimeters (60 inches) wide: 1½ inches by 1½ inches by 1/8 inches
- .2 Over 1500 millimeters (60 inches) wide: 2 inches by 2 inches by 1/8 inches

3.6 Equipment Bases and Curbs

- .1 All equipment shall be mounted on concrete bases, minimum 100 millimeters (4 inches) high.
- .2 A curb shall be provided around all piping passing through mechanical room floors, minimum 100 millimeters (4 inches) high.

- .3 Equipment bases and curbs shall be provided by the General Contractor. The Mechanical Contractor shall coordinate locations and sizes with the General Contractor.
- .4 Provide mounting plates to be formed into pads.

End of Section

- 1 General
 - 1.1 Scope
 - .1 Inertia bases.
 - .2 Vibration isolators.
 - 1.2 Reference Standard
 - .1 Provide and install mechanical equipment so that Average Noise Criteria curves, as outlined in A.S.H.R.A.E. Guide, are not exceeded.
 - 1.3 Submittals
 - .1 Provide vibration isolation shop drawings showing isolator locations, load on each isolator, inertia slab dimensions.
 - 1.4 General Requirements
 - .1 Supply vibration isolation equipment and materials by one supplier. Consider side loading of equipment and inertia bases when calculating maximum loads on isolators.
 - .2 Ensure equipment is sufficiently rigid for isolator point loading.
 - .3 All elastomer elements within the restraint shall be bridge bearing neoprene.
 - 1.5 Description
 - .1 Provide vibration isolation on all motor driven equipment with motors of 0.37 kilowatt and greater power output (as indicated on the motor nameplate) and on piping and ductwork, as specified herein. For equipment less than 0.37 kilowatt, provide neoprene grommets at the support points.
 - .2 Space isolators under equipment so that the minimum distance between adjacent corner isolators is at least equal to the height of the centre of gravity of the equipment. Include height of centre of gravity on shop drawings. Otherwise, design for increased forces on the supports, and submit design calculations with shop drawings for approval. In particular, chillers shall meet this requirement.
 - .3 Coordinate with Section 23 33 00 for flexible connections for all ductwork connections to fans or plenums.
 - .4 For all electrical connections to isolated equipment, provide a minimum 90 degree bend of flexible conduit.

- .5 Ensure isolation systems have a vertical natural frequency no higher than one third of the lowest forcing frequency, unless otherwise specified. Use dynamic stiffness for elastomers and do not exceed 60 durometer.
- .6 Provide horizontal limit springs on all fans (except vertical discharge) in excess of 1 kilopascal static pressure, and on hanger supported, horizontally mounted axial fans with more than 333 N. thrust due to static pressure.
- .7 Isolators and restraining devices which are factory supplied with equipment shall meet the requirements of this section.
- .8 Provide concrete inertia bases where specified or required by equipment manufacturers located between all vibrating equipment and the vibration isolation elements. Provide inertia bases on centrifugal fans with static pressure in excess of 875 pascals and/or motor in excess of 40 horsepower and on base mounted pumps over 10 horsepower, except slab on grade installations. Refer to structural specifications for concrete work. Concrete work by General Contractor.
- .9 Provide concrete inertia bases or structural steel bases for all other motor driven equipment, unless the equipment manufacturer certified direct attachment capabilities.
- .10 Coordinate with Division 3 for the provision of housekeeping pads at least 100 mm high under all isolated equipment. Provide at least 175 millimeters clearance between drilled inserts and edge of housekeeping pads and follow structural consultant's instructions for drilled inserts.
- .11 Bolt all equipment to the structure. Do not bridge isolation elements.
- .12 For non-isolated equipment (e.g., floor-mounted tanks, heat exchangers, boilers etcetera) design anchors and bolts for 2 g. applied horizontally through the centre of gravity.
- .13 For isolated equipment, design anchors, bolts, isolators and bases to withstand without failure or yielding a static load of 2 g., minimum, acting through the centre of gravity. For larger isolators, where the 2 g. requirement cannot be met, provide additional restraint meeting the N.B.C.C. requirements.
- .14 Where impact forces may be significant, use ductile materials.

1.6 Qualifications/Submittals

- .1 All equipment shall be tested in an independent testing laboratory, or certified by a registered professional engineer, to demonstrate that equipment meets the requirements of this section, e.g. static load capability equals 2 g., fail safe design, etcetera. If particular tests are carried out to

represent an isolator type, the tests shall be valid for the full load range of the isolator. Submit such tests or certification on request.

- .2 Obtain all relevant equipment information and provide shop and placement drawings for all vibration isolation elements and steel bases for review before materials are ordered. Provide attachment to both the equipment and the structure meeting the specified forces involved. Attachment details to the structure to be approved by a Provincially registered professional engineer.
- .3 Submit samples of materials required to complete the work of this section for inspection and review if and when requested.

2 Products

2.1 Isolators

- .1 Supply all vibration isolation equipment by one approved supplier with the exception of isolators which are factory installed and are standard equipment with the machinery.
- .2 All isolators shall be of the following types, supplied by the manufacturers named, or other acceptable manufacturers listed, or approved:

Type 1 - Pad Isolator

Neoprene/steel/neoprene pad isolators, manufactured from "Bridge bearing quality neoprene", as defined by C.S.A. Standard C.A.N. 3-S6-M78 Section 11.10. Select Type 1 pads for a 2.5 millimeters (0.1 inch) static deflection or greater. Bolt down equipment mounted on neoprene pad isolators using neoprene grommets. Design is based on Vibron Vibropad V.S.V. or Mason WMW, Super W.

Type 4 - Hangers

Spring hangers, complete with 6 millimeters (0.25 inch) thick sound pads sized for 0.5 millimeters (0.02 inch) minimum deflection, or neoprene hangers. Design is based on Vibron Series V.H., approved equal - Mason H.D., H.S. A neoprene element alone, without a hanger box, is acceptable provided no short circuiting occurs. Hangers shall allow for a minimum of 10° misalignment.

Type 5 - Air Isolator

Rolling lobe air springs with air spring levelling valves. Design based on Vibron MAS with levelling valves.

- .3 Select isolators at the supplier's optimum recommended loading, and do not load beyond the limit specified in the manufacturer's literature.

- .4 Design springs in accordance with the Society of Automotive Engineers' Handbook Supplement 9 entitled "Manual on Design and Application of Helical and Spiral Springs – S.A.E. - 1975".
- .5 Design springs "iso-stiff" ($k_x/k_y = 1.0$ to 1.5) with a working deflection between 0.3 and 0.6 of solid deflection.
- .6 Provide hot dipped galvanized housings and neoprene coated springs, or other acceptable weather protection, for all isolation equipment located out of doors or in areas where moisture may cause corrosion.
- .7 For all electrical connections to isolated equipment, provide a 90 degree bend of flexible conduit for 25 millimeters conduit and smaller or 90 degree Crouse-Hind E.C. couplings for larger conduit. Use connections long enough that the conduit will remain intact if the equipment moves laterally 300 mm from the installed position, and flexible enough to transmit less vibration to the structure than is transmitted through the springs.

2.2 Bases

- .1 Provide concrete inertia bases a minimum of 1.5 times the weight of the isolated equipment. Generally base thickness shall be 1/12 of the longest dimension of the base, but not less than 150 millimeters (6 inches). Include with base a steel channel concrete form with required steel reinforcement (as determined necessary by suppliers' registered professional engineer). Provide additional steel as required by sleeves or inserts to receive equipment anchor bolts. Use height saving brackets in all mounting locations to maintain a 50 millimeters (2 inches) clearance below the base. Bases are Mason type K. or approved equal. Bases to be furnished with built-in motor slide rails, Motor location as specified/scheduled.
- .2 Construct structural steel bases sufficiently rigid to keep deflection and misalignment within acceptable limits as determined by the equipment manufacturer. Use height saving brackets in all mounting locations to provide a base clearance of 50 millimeters (2 inches). Bases are Mason type W.F. or approved equal. Bases to be furnished with built-in motor slide rails. Motor location as specified/scheduled.
- .3 Construct bases strictly in accordance with the isolation suppliers' drawings.

2.3 Flexible Duct Connectors

- .1 Refer to Section 23 33 00.
- .2 Provide flexible duct connectors of Durodyne with Durolon fabric or approved equal.

2.4 Flexible Pipe Connectors

- .1 At the last elbow before piping leaves the mechanical room, and the first elbow entering, provide a bolted flanged 2000 millimeters long spool piece to facilitate the future installation of silencing equipment.

3 Execution

3.1 Execution

- .1 Execute the work in accordance with the specifications and, where applicable, in accordance with the manufacturer's instructions and only by workmen experienced in this type of work.
- .2 For all equipment mounted on vibration isolators, provide a minimum clearance of 50 millimeters to other structures, piping, equipment, etc.
- .3 Isolate all floor or pier mounted equipment on Type 2 isolators, unless otherwise specified.
- .4 Isolate all floor or pier mounted equipment on Type 3 isolators, unless otherwise specified. Isolate pumps rotating at more than 1170 revolutions per minute on Type 2 isolators. Use the lowest revolutions per minute scheduled for two speed equipment in determining isolator deflection.
- .5 For equipment mounted on a slab on grade, absorption chillers and in-line pumps, mount on Type 2 isolators, unless otherwise specified. Use Type 1 pads only where approved.
- .6 Select Type 4 spring hangers for a minimum static deflection of 25 mm for all ceiling hung fans, and air handling units, emergency generator exhaust piping and silencers, steam P.R.V.'s and any other vibrating sources.
- .7 Provide Type 4 resilient hangers on all piping connected to a vibrating source, if the piping is in excess of 40 millimeters diameter. Provide the hangers for a distance of 6.5 meters for a 50 millimeters pipe and 11.5 meters for a 250 millimeters pipe. Isolate all other pipe for a proportionate distance. Isolate all piping in mechanical rooms. If neoprene hangers are proposed for non-critical spaces, change to spring hangers at no additional cost in the event that the isolation proves inadequate.
- .8 Where piping connected to noise generating equipment is routed from the mechanical room through plumbing chases, position piping to avoid contact with the concrete structure, future framing, drywall and other finishes which may radiate noise. Submit proposed details to meet this requirement.
- .9 Where the weight of equipment located on type 3 isolators may change significantly due to draining or similar as in cooling towers or chillers, provide limit stops to limit spring extensions.
- .10 Provide spring isolators on piping connected to isolated equipment to a minimum as follows: up to 100 millimeters diameter, first 3 points of support;

125 millimeters to 200 millimeters diameter, first 4 points of support; 250 millimeters diameter and over, first 6 points of support. Static deflection of first point shall be twice deflection of isolated equipment.

- .11 Provide spring isolators on all piping in mechanical and boiler rooms.
 - .12 For in-line pumps 18.6 kilowatts and greater, provide two (2) type 2 isolators under each support foot. Provide Type 6 post-disaster anchors for all base mounted isolated equipment.
 - .13 Where piping or boiler exhaust stacks, etc., connected to or serving noise generating equipment, is routed from the mechanical room through walls and plumbing chases, position piping, stacks, etc. to avoid contact with the concrete structure, future framing, drywall and other finishes which may radiate noise. Submit proposed details to meet this requirement. Provide 6.5 bar controls compressed air to Type 5 isolators.
 - .14 Where a pump intake pipe or similar pipe configuration requires a pedestal support, construct inertia or steel base large enough to accommodate pedestal. Provide flexible pipe connections for all pipe connections to chillers.
 - .15 Provide resilient elements in pipe anchors, where pipe anchors are specified within 11.5 meters of a vibration source. Submit details before installation. Protect neoprene isolator components from overheating. Where piping connects new and existing buildings provide flexibility in piping by elbows, offsets, or 2 flexible pipe connectors 30 pipe diameter apart to isolate one building from another.
- 3.2 Duct Connections to Isolated Equipment
- .1 Provide 75 millimeters flexible duct connectors and a 40 millimeters metal to metal gap.
 - .2 Provide stabilizing springs limiting movement at flexible connections to 25 percent of fabric width under steady state conditions and 40 percent at start up.
 - .3 Flexible duct connections shall be installed so that duct size is not reduced by the deflection of the flexible connector.
- 3.3 Inspections
- .1 The supplier shall provide assistance to the contractor as necessary during the course of installation of isolation equipment. Prior to substantial completion, submit a report listing deficiencies to the specification.

End of Section

1 General

1.1 General

- .1 It is the intent of this seismic specification to keep all mechanical building system components in place during a seismic event.
- .2 All such systems must be installed in strict accordance with seismic codes, component manufacturers and building construction standards. Whenever a conflict occurs between the manufacturers or construction standards, the most stringent shall apply.
- .3 Seismic restraints shall be designed in accordance with seismic requirements outlined in Part 4 of the Ontario Building Code.
- .4 The work in this section includes, but is not limited to the following:
 - .1 seismic restraints for isolated equipment.
 - .2 seismic restraints for non-isolated equipment.
 - .3 certification of seismic restraint designs and installation supervision.
 - .4 all mechanical systems (equipment not listed is still included in this specification).
 - .5 Air handling units, fans, conduit (solid bracing only), piping, and ductwork

1.2 Submittals

- .1 Product Data: include seismic rating curve for each seismically rated isolator or restraint component.
- .2 Shop Drawings: include the following:
 - .1 Design calculations: calculate requirements for selecting vibration isolators and seismic restraints. Certification documents to be signed and sealed by a qualified professional engineer with at least 5 years' experience in the design of seismic restraints.
 - .2 Seismic-restraint details: detail submittal drawings of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
 - .3 Submittals for interlocking snubbers: include ratings for horizontal, vertical and combined loads.
 - .4 Equipment manufacturer seismic qualification certification: the equipment manufacturer must submit certification that each piece of provided equipment will withstand seismic forces. Include the following:

1. Basis for certification: indicate whether the “withstand” certification is based on actual test of assembled components or on calculations.
2. Indicate the equipment is certified to be durable enough to:
 - .1 Structurally resist the design forces and/or
 - .2 Will also remain functional after the seismic event.
- .5 Dimensioned outline drawings of equipment unit: identify center of gravity and locate and describe mounting and anchorage provisions.
- .6 Detailed description of the assumed equipment anchorage devices on which the certification is based.

1.3 Description of System

- .1 It shall be understood that the requirements of this seismic restraint section are in addition to other requirements as specified elsewhere for the support and attachment of equipment and mechanical services, and for the vibration isolation of same equipment. Nothing on the project drawings or specifications shall be interpreted as justification to waive the requirements of this seismic restraint section.
- .2 All seismic snubber restraint assemblies shall meet the following minimum requirements:
 - .1 The snubber shall include a high quality elastomeric element that will ensure that no un-cushioned shock can occur.
 - .2 It shall be possible to visually inspect the resilient material for damage and replace it if necessary.
 - .3 Resilient material used in snubber assemblies to be a minimum of 0.25 inches (6 millimeters) thick.
 - .4 Resilient material used in snubber grommets to be a minimum of 0.12 inches (3 millimeters) thick.
 - .5 All interlocking snubbers to include a maximum air gap of 0.25 inches (6 millimeters).
 - .6 Assembly must be designed to offer seismic restraint in all directions, unless otherwise noted below.
 - .7 Seismic restraint capacities to be verified by an independent test laboratory or certified by an experienced registered professional engineer to ensure that the design intent of this specification is realized.

1.4 System Design

- .1 Seismic snubber manufacturer shall be responsible for the structural design of attachment hardware as required to attach snubbers to both the equipment and supporting structure on vibration isolated equipment, or to directly attach equipment to the building structure for non-isolated equipment.
- .2 The contractor shall furnish a complete set of approved shop drawings of all mechanical and electrical equipment which is to be restrained to the seismic restraint manufacturer, from which the selection and design of seismic restraint devices and/or attachment hardware will be completed. The shop drawings furnished shall include, at a minimum, basic equipment layout, length and width dimensions, installed operating weights of the equipment to be restrained and the distribution of weight at the restraint points.
- .3 All piping and ductwork is to be restrained to meet code requirements. Spacing between restraints is not to exceed the allowable spacing listed in the latest revision of the S.M.A.C.N.A. manual (Sheet Metal And Air Conditioning Contractors National Association, Inc.) "seismic restraint manual guidelines for mechanical systems", most recent edition. At a minimum, the seismic restraint manufacturer shall provide documentation on maximum restraint spacing for various cable sizes and anchors, as well as 'worst case' reaction loads at restraint locations. In addition, seismic restraint manufacturer shall provide support documentation containing adequate information to allow the installation contractor to make reasonable field modifications to suit special case conditions.

1.5 Installation

- .1 Installation of all seismic restraint materials specified herein shall be accomplished following the manufacturer's written instructions. Installation instructions shall be submitted to the engineer for approval prior to the beginning of the work.

2 Products

2.1 Source of Materials

- .1 All seismic snubbers and combination snubber / vibration isolation materials specified herein shall be provided by a single manufacturer to assure sole source responsibility for the proper performance of the materials used. Manufacturer is to be a member of V.I.S.C.M.A. (Vibration Isolation And Seismic Control Manufacturers Association).
- .2 Mechanical anchor types and sizes are to be per the design data as provided by the seismic restraint manufacturer.

- .3 Materials and systems specified herein and detailed are based upon materials manufactured by Kinetics Noise Control, Incorporated. Materials and systems provided by other manufacturers are acceptable, provided that they meet all requirements as listed in this specification.
- .4 Where not protected by a shield, resilient materials shall be easy to visually inspect for damage.

2.2 Factory Finishes

- .1 Manufacturer's standard prime-coat finish ready for field painting.
- .2 Finish: manufacturer's standard paint applied to factory-assembled and tested equipment before shipping.
- .3 Powder coating on springs and housings.
- .4 All hardware shall be electrogalvanized. Hot-dip galvanize or powder coat metal housings for exterior use.
- .5 Enamel or powder coat metal components on isolators for interior use.
- .6 Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

2.3 Seismic Restraint Isolation

- .1 Isolators:
 - .1 Vibration/seismic spring floor mounts: Type F.H.S. – spring isolators shall be seismically restrained spring isolators, incorporating a single vibration isolator.. Spring isolators shall be model FHS as manufactured by Kinetics Noise Control, Incorporated, or acceptable equal.
 - .2 Vibration/seismic restrained spring isolator: Type F.L.S.S. – vibration isolators shall be seismically rated, restrained spring isolators for equipment which is subject to load variations and large external forces. Vibration isolators shall be model F.L.S.S. as manufactured by Kinetics Noise Control, Incorporated, or acceptable equal.
 - .3 Vibration/seismic modular restrained spring isolator: Type F.M.S. (A., B., C., D., E., F.) – the isolator/restraint shall be model F.M.S. (A., B., C., D., E., F.) as manufactured by Kinetics Noise Control, Incorporated, or acceptable equal.
 - .4 All direction neoprene isolator: Type R.Q. - vibration isolators shall be neoprene, molded from oil resistant compounds, designed to operate within the strain limits of the isolator so to provide the maximum isolation and longest life expectancy possible using

neoprene compounds.. Neoprene isolators shall be model R.Q. as manufactured by Kinetics Noise Control, Incorporated, or acceptable equal.

2.4 Seismic Restraints

.1 Seismic Restraint Devices:

- .1 Seismic cable restraints: seismic wire rope cable restraints shall consist of steel wire strand cables, sized to resist project seismic loads, arranged to offer seismic restraint capabilities for piping, ductwork, and suspended equipment in all lateral directions. Seismic cable(s) with use of “u” clips and or Kinetics Quakelocs shall be as manufactured by Kinetics Noise Control, Incorporated, or acceptable equal.
 1. Seismic cable building and equipment attachment brackets shall be model KSUA or KSCA as manufactured by Kinetics Noise Control, Incorporated.
 2. Seismic cable concrete anchor bolts shall be model K.C.A.B. wedge, model K.C.C.A.B. cracked concrete, model K.U.A.B. undercut or K.A.A.B.C. adhesive, as manufactured by Kinetics Noise Control, Incorporated.
- .2 Hanger rod stiffener: Type K.H.R.C. – seismic rod stiffener angle bracing shall be securely attached to hanging thread rod by a series of attachment clamps. Attachment clamps shall be manufactured from a one piece metal stamping, and shall include all required attachment hardware and locking nuts. Seismic rod stiffener angle attachment clamps shall be model KHRC as manufactured by Kinetics Noise Control, Incorporated, or acceptable equal.
- .3 Seismic beam clamps: Type K.S.B.C. – seismic beam clamps shall be model KSBC as manufactured by Kinetics Noise Control, Incorporated, or acceptable equal.
- .4 Seismic restraint brackets: type K.S.M.S./K.S.M.G. – formed steel brackets for securing floor-mounted equipment complete with pre-drilled holes. Seismic brackets shall be model K.S.M.S./K.S.M.G. as manufactured by Kinetics Noise Control, Incorporated, or acceptable equal.
- .5 Seismic snubbers: structural steel angle(s) with surfaces covered with ribbed neoprene pads to cushion contact with snubber. Snubbers shall be designed to limit equipment motion to no more than 6 millimeters (¼ inch) in any direction.

1. Type H.S.-1 (1-axis): single-axis snubbers shall be model H.S.-1 by Kinetics Noise Control, Incorporated or acceptable equal.
 2. Type H.S.-2 (2-axis): two-axis lateral snubbers shall be model H.S.-2 by Kinetics Noise Control, Incorporated or acceptable equal.
 3. Type H.S.-5 (3-axis): three-axis seismic snubbers shall be model H.S.-5 as manufactured by Kinetics Noise Control, Incorporated or acceptable equal.
 4. Type K.R.M.S. (3-axis): three-axis seismic neoprene isolator restraint shall be model K.R.M.S. as manufactured by Kinetics Noise Control, Incorporated or acceptable equal.
- .6 Concrete anchor bolts: post-installed anchors in concrete shall be qualified for seismic restraint application in accordance with A.C.I. 355.2.
1. Mechanical anchor bolts: the seismic certification by Kinetics Noise Control, Incorporated. Uses the models: K.C.A.B. wedge type anchor; K.C.C.A.B. cracked concrete type anchor; K.U.A.B. undercut heavy-duty concrete type anchor. Any anchors that are substituted and/or supplied by others must be evaluated and approved by the design professional of record.
 2. Adhesive anchor bolts: drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. The seismic certification by Kinetics Noise Control, Incorporated. Uses the models: K.A.A.B.C. (carbon steel for indoor use) adhesive anchor; K.A.A.B.S. (stainless steel for external use) adhesive anchor. Any adhesive type anchors that are substituted and/or supplied by others must be evaluated and approved by the design professional of record.
- .7 Grommet washers: Type T.G. -. Anchor bolt isolation grommet shall be model TG as manufactured by Kinetics Noise Control, Incorporated, or acceptable equal.

3 Execution

3.1 Installation

- .1 Installation of all seismic restraint materials specified in this section shall be accomplished as per the manufacturer's written instructions.

- .2 Upon completion of installation of all seismic restraint materials and before start up of restrained equipment, all debris shall be cleaned from beneath all protected equipment, leaving equipment free to contact snubbers.
- .3 No rigid connections between the equipment and the building structure shall be made which degrades the seismic restraint system herein specified. All electrical conduit to restrained equipment shall be looped to allow free motion of equipment without damage to the electrical wiring.
- .4 Adjust isolators after piping systems have been filled and equipment is at operating weight.
- .5 Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- .6 Adjust snubbers according to manufacturer's written recommendations.
- .7 Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
- .8 Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces

3.2 Execution

- .1 Shackle piping to the trapeze when restraining trapeze mounted piping, conduit and ductwork. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
- .2 Install steel angles to stiffen hanger rods and prevent buckling where appropriate. Clamp with adjustable steel clamps to hanger rods. Requirements apply equally to hanging equipment. Do not weld angles to rods
- .3 If there is greater than a 1/8 inch diameter mismatch between anchorage hardware and hole diameter, reduce clearance in hole with epoxy grout or flanged neoprene bushings.

3.3 Seismic Restraint For Equipment:

- .1 Seismically restrain equipment as required by code. Install fasteners, straps and brackets as required to secure the equipment.
- .2 Install seismic snubbers on H.V.A.C. equipment supported by floor-mounted, non-seismic vibration isolators. Position snubbers as necessary and attach to equipment base and supporting structure as required.
- .3 Install neoprene grommet washers or fill the gap with epoxy on equipment anchor bolts where clearance between anchor and equipment support hole exceeds 3.2 millimeters (0.125 inch).

- .4 Suspended Equipment: all suspended equipment that meets any of the following conditions requires seismic restraints as specified by the supplier:
 - .1 Rigidly attached to pipe or duct that is 75 pounds. And greater,
 - .2 Items hung independently or with flexible connections greater than 20 pounds For importance factors greater than 1.0 all suspended equipment requires seismic restraints regardless of the above notes.
 - .3 Wall mounted equipment weighing more than 20 pounds. With an importance factor of 1.0.
 - .4 The 12 inch rule does not apply to suspended equipment.
 - .5 Base Mounted Equipment: all base mounted equipment that meets any of the following conditions requires attachments and seismic restraints as specified the supplier:
 - .1 Connections to or containing hazardous material,
 - .2 With an overturning moment,
 - .3 Weight greater than 400 pounds,
 - .4 Mounted on a stand 4 feet. Or more from the floor.
 - .5 For importance factors greater than 1.0 all base mounted items require seismic restraints regardless of the above notes.
 - .6 Rigid Mounted Equipment:
 - .1 Anchor floor and wall mounted equipment to the structure as per the stamped seismic certifications/drawings.
 - .2 Suspended equipment shall be restrained using seismic cable restraints, or struts, and hanger rods as per the stamped seismic certifications / drawings.
 - .7 Vibration Isolated Equipment:
 - .1 Seismic control shall not compromise the performance of noise control, vibration isolation or fire stopping systems.
 - .2 Equipment supported by vibration-isolation hangers shall be detailed and installed with approximately a 1/8 inch gap between the isolation hangers and the structure. Isolators at restraint locations must be fitted with uplift limit stops.
- 3.4 Seismic Restraint For Piping, Duct:
- .1 All piping, duct are to be restrained to meet code requirements.

- .1 All piping systems assigned a component importance factor of 1.5 shall require seismic restraints. Seismic restraint requirements/exemptions vary with code and seismic acceleration – see specific code and comply with applicable restraint requirements.
 - .2 Piping associated with an importance factor of 1.0 may not require seismic restraint; see specific code for requirements.
 - .3 Seismically restrain/brace all pipes 65 millimeters (2 ½ inches) in nominal diameter and larger.
 - .4 Seismically restrain brace all piping in boiler rooms, mechanical rooms and refrigeration mechanical rooms 32 millimeters (1 ¼ inches) in nominal diameter and larger.
 - .5 Seismically restrain/brace all gas (i.e.: natural gas, medical gas, vacuum, petroleum based liquid, compressed air, etcetera.) Piping 25 millimeters (1 inch) in nominal diameter and larger.
 - .6 Branch lines may not be used to brace main lines.
- .2 Restraint spacing for piping:
- .1 For ductile piping: transverse supports a maximum of 12 meters (40 feet) o.c.
 - .2 For ductile piping: longitudinal supports a maximum of 24 meters (80 feet) o.c.
 - .3 For non-ductile piping (e.g., cast iron, p.v.c.) space transverse supports a maximum of 6 meters (20 feet) o.c., and longitudinal supports a maximum of 12 meters (40 feet) o.c. Differential spacing can be designed depending upon pipe size and length(s) of run.
 - .4 For piping with hazardous material inside (e.g., natural gas, medical gas) space transverse supports a maximum of 6 meters (20 feet) o.c., and longitudinal supports a maximum of 12 meters (40 feet) o.c.
 - .5 For pipe risers, restrain the piping at floor penetrations using the same spacing requirements as above.
- .3 Seismically restrain per specific code requirements, all ductwork listed below (unless otherwise indicated on the drawings), using seismic cable restraints:
- .1 All ducts with cross sectional area equal to or greater than 0.55 meters squared (6 feet squared).
 - .2 All round ducts with diameters equal to or greater than 28 inches

- (710 millimeters).
- .3 Any ductwork, pipe or equipment, which if it were to fail would result in damage to a piece of equipment or building function that has a component importance factor of 1.5.
 - .4 All ductwork weighing more than 25 kilograms per meter (17 pounds per foot.).
 - .4 Restraint spacing for ductwork:
 - .1 Transverse supports a maximum of 9 meters (30 feet) o.c.
 - .2 Longitudinal supports a maximum of 18 meters (60 feet) o.c.
 - .5 Installation requirements and notes:
 - .1 Brace a change of direction longer than 3.7 meters (12 feet).
 - .2 This specification does not allow the use of the “12-inch rule” where the piping, duct and electrical may be exempted from seismic restraint based on the length of the support rods provided that the rods are not subjected to bending moments.
 - .3 Install restraint cables so they do not bend across edges of adjacent equipment or building structure. Tie back to structure at 45 degrees to the structure.
 - .4 Longitudinal restraints for single pipe supports shall be attached rigidly to the pipe, not to the pipe hanger.
 - .5 For supports with multiple pipes (trapezes), secure pipes to trapeze member with clamps approved for application.
 - .6 Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement.
 - .7 Install flexible piping connectors where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.
 - .8 Where pipe sizes reduce below required dimensions noted above in herein, the final restraint shall be installed at the transition location.
 - .9 Where duct sizes reduce below required dimensions noted herein, the final restraint shall be installed at the transition location.
 - .10 Longitudinal restraints for single conduit supports shall be attached rigidly to the pipe, not to the pipe/conduit hanger.

- .11 For supports with multiple conduits (trapezes), secure conduit to trapeze member with clamps approved for application.
- .12 Where conduit, bus ducts, cable trays sizes reduce below required dimensions noted herein, the final restraint shall be installed at the transition location.
- .13 Rod stiffener clamps are required where the hanger rod exceeds the maximum length shown in the seismic calculation sheets. They are only required at restraint locations.
- .14 Seismically rated beam clamps are required where welding to or penetrations to steel beams are not approved.
- .15 Adjust restraint cables so that they are not visibly slack. Cable not to support weight during normal operation.
- .16 Seismic systems are to be compatible with requirements for anchoring and guiding of systems.
- .17 Drilled or power driven anchors or fasteners shall not be permitted for use with seismic control measures.
- .18 Friction due to gravity does not constitute a seismic attachment.
- .19 Seismic restraint connections are not to be connected to the bottom chord of steel joists or the bottom flange of steel beams.
- .20 Standard beam clamps can be used to support restrained components; they cannot be used to connect the seismic restraint to the structure – only for the hanger rods.
- .21 Brace remaining piping, ductwork, electrical components to code requirements (O.B.C.) or in conformance with S.M.A.C.N.A. (Sheet Metal And Air Conditioning Contractors National Association, Incorporated.) “Seismic Restraint Manual Guidelines For Mechanical Systems”, 2nd Edition.

3.5 Inspection

- .1 The contractor shall notify the local representative of the seismic restraint materials manufacturer prior to installing any seismic restraint devices. The contractor shall seek the representative's guidance in any installation procedures with which he is unfamiliar.
- .2 Upon completion of the installation of all seismic restraint devices herein specified, the local representative of the seismic snubbers manufacturer shall, at the contractors request, inspect the completed system and report in writing any installation errors, improperly selected snubber devices, or other fault in the system which could affect the performance of the system.

- .3 The installing contractor shall submit a report upon request to the building architect and/or engineer, including the manufacturer's representative's final report, indicating that all seismic restraint material has been properly installed, or steps to be taken by the contractor to properly complete the seismic restraint work as per the specifications.

End of Section

1 General

1.1 References

- .1 Canadian General Standards Board (C.G.S.B.)
 - .1 C.A.N./C.G.S.B.-1.60-M89, Interior Alkyd Gloss Enamel.
 - .2 C.A.N./C.G.S.B.-24.3-92, Identification of Piping Systems.
- .2 Canadian Standards Association (C.S.A.)
 - .1 Natural Gas Installation Code C.S.A. B149.1-15

1.2 Product Data

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

1.3 Product Literature

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

2 Products

2.1 Manufacturer's Equipment Nameplates

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

2.2 System Nameplates

- .1 Colours:
 - .1 Hazardous: red letters, white background
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 millimeters (1/8 inch) thick laminated plastic, matte finish, with

square corners, letters accurately aligned, and machine engraved into core.

.3 Sizes:

.1 Conform to the following table:

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

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

.4 Locations:

.1 Terminal cabinets, control panels: Use size 5.

.2 Equipment in Mechanical Rooms: Use size 9.

.3 Rooftop equipment: Use size 9.

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

2.3 Piping Systems Governed by Code

.1 Natural Gas:

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

2.4 Identification of Piping Systems

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To C.A.N./C.G.S.B. 24.3 except where specified otherwise.
- .2 Legend:
 - .1 Block capitals to sizes and colours listed in C.A.N./C.G.S.B.-24.3.
- .3 Arrows showing direction of flow:
 - .1 Outside diameter of pipe insulation less than 75 millimeters (3 inches): 100 millimeters (4 inches) long by 50 millimeters (2 inches) high.
 - .2 Outside diameter of pipe or insulation 75 millimeters (3 inches) and greater: 150 millimeters (6 inches) long by 50 millimeters (2 inches) high.
 - .3 Use double-headed arrows where flow is reversible.
- .4 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and

arrows.

.5 Materials for background colour marking, legend, arrows:

- .1 Pipes and tubing 20 millimeters (3/4 inch) and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
- .2 All other pipes: Pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating suitable for ambient of 100 percent Relative Humidity and continuous operating temperature of 150 degrees Celsius (300 degrees Fahrenheit) and intermittent temperature of 200 degrees Celsius (395 degrees Fahrenheit).

.6 Colours and Legends:

- .1 Where not listed, obtain direction from Consultant.
- .2 Colours for legends, arrows:

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

2.5 Concrete Pads for Mechanical Equipment

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

2.6 Identification Ductwork Systems

- .1 50 millimeters (2 inches) high stenciled letters and directional arrows 150 millimeters (6 inches) long by 50 millimeters (2 inches) high.
- .2 Colours: Black or coordinated with base colour to ensure strong contrast.

2.7 Valves, Controllers

- .1 Brass tags with 15 millimeters (1/2 inch) stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.
- .3 Provide coloured adhesive label indication on ceiling grid to locate valves/equipment above. Label description to match device. Size, colour and description to be pre-approved by Consultant.

2.8 Controls Components Identification

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

2.9 Language

- .1 Identification to be in English.

3 Execution

3.1 Timing

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

3.2 Installation

- .1 Perform work in accordance with C.A.N./C.G.S.B.-24.3 except as specified otherwise.
- .2 Provide U.L.C. and/or C.S.A. registration plates as required by respective agency.

3.3 Nameplates

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate or cover in any way.

3.4 Location of Identification on Piping and Ductwork Systems

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels not more than 1.7 meters (5 feet, 8 inches) intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork

passes.

- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification to be easily and accurately readable from usual operating areas and from access points. Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 Valves, Controllers

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

End of Section

1 General

1.1 Costs

- .1 All balancing work shall be included in the mechanical contractors tender price.

1.2 Work Included

- .1 Review location of all balancing valves on drawings for air and water systems prior to construction and submit recommendations for additional balancing dampers or balancing valves to perform complete system balancing.
- .2 Test, balance and adjust all new air and water systems and equipment and submit reports.
- .3 Allow for a minimum of one (1) return visit for any adjustments and/or to work with the Contractor to investigate any issues.

1.3 Scope of Work

- .1 Review design drawings and general function of each system including associated equipment, control sequences and operation cycles. Confirm listing of flow and terminal measurements to be performed.
- .2 Confirm balancing valve and damper locations are adequate for system balancing. Recommend additional locations to Contractor and Consultant if required to complete system balancing.
- .3 Outline procedures for taking test measurements to establish compliance with requirements. Specify type of instrument to be used, method of instrument application and correct factors.
- .4 Test, balance and adjust entire air and hydronic water systems, including snow melt, upon completion of the work. Use approved report format as approved by the Consultant to record all results. Submit sample to Consultant for approval prior to balancing.
- .5 Contact Consultant during or immediately following balancing procedures to discuss any concerns or issues prior to issuing any reports.
- .6 Submit one (1) copy of the Balance Report to the Consultant for review.
- .7 Make adjustments as directed by the Consultant. Include for a minimum of one (1) return visit for any adjustments and/or to work with the Contractor to investigate any issues.
- .8 Revise report and resubmit to the Consultant for review.

1.4 Balance Reports

- .1 Use a format acceptable to the Consultant for Reports.
- .2 Submit one (1) copy of the report to the Consultant for review within one (1) week from balance completion and prior to inclusion into Maintenance Manuals. Include any comments or concerns from system balancing on report.
- .3 Reports shall include equipment data, design data and balance results in metric and imperial units.
- .4 Report shall include but not be limited to:
 - .1 Balancing Company
 - .2 Balancing Agent who performed the work
 - .3 Date the balancing was performed
 - .4 Date of report
 - .5 Tools and apparatus used for testing including calibration information
 - .6 System description
 - .7 Equipment manufacturer, model, arrangement, size, performance, fan size (if applicable), motor size, voltage and amperage
 - .8 Design and actual air flows (supply air, return air, outside air)
 - .9 Design and actual water flows
 - .10 Setting of balancing valves
 - .11 Design and actual pressure drops (air and water)
 - .12 Electrical characteristics
 - .13 Design and actual motor F.L.A., R.P.M.
 - .14 Comments or concerns on findings
- 1.5 Acceptable Balancing Agencies
 - .1 Any accredited N.E.B.B., C.A.A.B.C. or N.B.C.T.A. balancing company.
- 2 Products
 - 2.1 All equipment and products necessary to perform tests shall be provided and covered by the Balancing Agent.
 - 2.2 Maintenance Manual Materials
 - .1 Provide copies of the reports to the Contractor for inclusion in the manuals.

3 Execution

3.1 General

- .1 Coordinate with system installers to confirm location of all balancing dampers and balancing valves. Balance dampers and valves required in addition to those shown on the drawing must be coordinated prior to installation.
- .2 Balance to maximum measured flow deviation from specified values of 10 percent at terminal device and 5 percent at equipment.
- .3 Mark settings on valves, splitters, dampers and other adjustment devices.
- .4 Include any required site investigation and system balancing based on any system deficiencies as noted herein.
- .5 Contact Consultant during or immediately following balancing procedures to discuss any concerns or issues prior to issuing any reports.
- .6 At final inspection, recheck and prove random selections of data recorded in report at discretion and direction of the Consultant.

3.2 Air System Procedure

- .1 Adjust air handling and distribution systems to provide required or design supply and return air quantities.
- .2 Make air quantity measurements in ducts by pitot tube traverse of entire cross-sectional area of duct.
- .3 Measure air quantities at air inlet and outlet.
- .4 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Affect volume control by duct internal devices, such as dampers and splitters.
- .5 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.
- .6 Provide system schematic with required and actual air quantities at each outlet or inlet.

3.3 Water System Procedure – Hydronic Systems

- .1 Adjust water systems to provide required or design quantities.
- .2 Use calibrated venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

- .3 Adjust systems to provide specified pressure drops and flow through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- .4 Effect system balance with automatic control valves fully open to heat transfer elements.
- .5 Effect adjustment of water distribution systems by means of balancing cocks, valves and fittings. Do not use service or shutoff valves for balancing unless indexed for balance point.
- .6 Where pump capacity available is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.4 Reports

- .1 Submit written reports for all balancing in a format pre-approved by the Consultant as per Scope of Work above.
- .2 Submit one (1) copy of the Balance Report to the Consultant for review.
- .3 Make adjustments as directed by the Consultant. Include for a minimum of one (1) return site visit as noted herein.
- .4 Revise report and resubmit to the Consultant for review.
- .5 Fan Test Reports
 - .1 Report air flow; air pressure at inlet and discharge; fan speed; motor current; motor voltage; manufacturer; model; fan wheel size.
 - .2 For fans with power greater than 250 watts, plot design and actual pressure and flow on manufacturer's or drafted fan performance curve.
- .6 Pump Test Reports
 - .1 Report designed water flow; water pressure at inlet and discharge; pump speed; motor current; motor voltage; manufacturer; model; impeller size.
 - .2 For pumps with power greater than 250 watts, plot design and actual pressure and flow on manufacturer's or drafted pump performance curve.
- .7 Upon acceptance of the report, provide copies of final report for maintenance manuals.

End of Section

- 1 General
 - 1.1 Work Included
 - .1 Duct thermal insulation
 - .2 Duct acoustic insulation
 - .3 Recovering
 - 1.2 Quality Assurance
 - .1 All workers engaged in the application of insulation shall be journeymen, or indentured apprentices working under a journeyman who is on the site.
 - 1.3 Job Conditions
 - .1 Deliver material to job site in original nonbroken factory packaging, labeled with manufacturer's density and thickness.
 - .2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.
- 2 Products
 - 2.1 General
 - .1 Adhesives, Insulation, Coatings, Sealers and Recovering Jackets shall have composite fire and smoke hazard ratings not exceeding 25 for flame spread and 50 for smoke developed.
 - .2 Adhesives, coatings and sealers shall be waterproof.
 - 2.2 Thermal Duct Insulation
 - .1 Insulation shall be pre-covered, preformed insulation complete with foil or kraft all purpose jacket unless otherwise noted.
 - .2 Use 25 millimeters (1 inch) thick insulation unless otherwise noted
 - .3 Exposed Rectangular Ducts: Rigid fibrous glass insulation, "K" value at 0.24 b.t.u. per inch per square foot per degree Fahrenheit per hour with factory applied reinforced aluminum foil vapour barrier.
 - .4 Round Ducts and Concealed Rectangular Ducts: Flexible fibrous glass insulation, "K" value at 0.26 b.t.u. per inch per square foot per degree Fahrenheit per hour with factory applied reinforced aluminum foil vapour barrier.
 - .5 Recovering Jackets (Interior): U.L.C. listed "Thermo Canvas", treated cotton fabric

.6 Acceptable Manufacturers:

- .1 Fibreglass Canada
- .2 Knauf
- .3 Mason

2.3 Acoustic Duct Insulation

- .1 Fiberglass insulation with "K" value at 0.26 b.t.u. per inch per square foot per degree Fahrenheit per hour absolute roughness of exposed surface not to exceed 0.033 millimeters coated to prevent fibre erosion at air velocities up to 400 f.p.m.
- .2 All substrate material to be non-darkened, contrasting colour from liner layer.
- .3 Use 25 millimeters (1 inch) thick insulation unless otherwise noted.

3 Execution

3.1 Preparation

- .1 Do not install covering before ductwork and equipment has been tested and approved.
- .2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

3.2 Installation - General

- .1 In non fire rated surfaces, ensure insulation is continuous through inside walls. Pack around ducts with fireproof self-supporting insulation material properly sealed.
- .2 Finish insulation neatly at hangers, supports and other protrusions.
- .3 Locate insulation or cover seams in least visible locations.

3.3 Thermal Duct Insulation

- .1 Provide insulation on:
 - .1 All outside air and exhaust air ductwork between outside walls and E.R.V.
 - .2 All supply air ductwork off heat pumps in non-plenum ceilings (including Corridors).
 - .3 Outside air intakes and plenums in all areas.

- .4 Exhaust air ductwork within 2.4 meters (8 feet) of insulated surface penetration.
 - .5 Combustion air ductwork in Mechanical Room.
 - .2 Exposed Rectangular Ducts: Secure rigid insulation with 50 percent coverage of adhesive and 12 gauge galvanized impale anchor tabs on 400 millimeters (16 inches) centres. Seal joints with 100 millimeters (4 inches) wide foil tape.
 - .3 Round Ducts and Concealed Rectangular Ducts: Adhere flexible insulation to ductwork with adhesive applied in 150 millimeters (6 inches) wide strips on 400 millimeters (16 inches) centres. Provide 16 gauge annealed tie wire, or polypropylene twine, spiral wound or half hitched at 100 millimeters (4 inches) centres for securing duct insulation until adhesive sets. Butt insulation and seal joints and breaks with 100 millimeters (4 inches) foil tape.
- 3.4 Acoustic Duct Insulation
- .1 Apply to interior of:
 - .1 First 3 meters (10 feet) of supply AND return ducts on inlet and discharge of E.R.V. and R.T.U.'s.
 - .2 First 1.5 meters (5 feet) of supply AND return ducts on inlet and discharge of Heat Pumps, Exhaust Fans and remaining air handling equipment.
 - .3 All ductwork for Gym Stage and Library within Mechanical Room and as indicated on drawings.
 - .4 Transfer ducts and elbows.
 - .5 As indicated on drawings.
 - .2 Secure to ductwork with adhesive using 50 percent coverage and 12 gauge impale anchor tabs on 400 millimeters (16 inches) centres. Cut off excess fastener length and cover with brush coat of sealer.
 - .3 Shop fabrication cuts shall be coated with J.M.'s SuperSeal Duct Butter and Edge Treatment products.
 - .4 Seal all cut and exposed ends.
- 3.5 Canvas Recovering Jacket
- .1 Provide recovering jackets on exposed insulation throughout including but not limited to Mechanical Rooms.
 - .2 Coat recovering jacket with two coats of waterproof fire retardant coating.

End of Section

- 1 General
 - 1.1 Work Included
 - .1 Piping Insulation
 - .2 Adhesives, Tie wires, Tapes
 - .3 Recovering
 - 1.2 References
 - .1 A.S.T.M. C547 Specification for Mineral Fiber Pipe Insulation
 - .2 A.S.T.M. C552 Standard Specification for Cellular Glass Thermal Insulation
 - .3 A.S.T.M. C585 Practice for Inner and Outer Diameter of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (N.P.S. System)
 - .4 A.S.T.M. E84 Test Method for Surface Burning Characteristics of Building Materials
 - .5 C.A.N./U.L.C. S102 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .6 A.S.T.M. C1729 Standard Specification for aluminum jacketing for Insulation
 - 1.3 Quality Assurance
 - .1 All workers engaged in the application of insulation shall be journeymen, or indentured apprentices working under a journeyman who is on the site. Trades Qualification certificates must be submitted prior to commencing work and must be on site for inspection.
 - .2 All installation work shall conform with the information in the NAIMA Guide for Chilled Water Pipe Systems Insulated with Mineral Fiber Insulation or other accepted industry and trade installation standards for commercial and industrial insulations, or shall conform with manufacturer's recommendations.
 - 1.4 Submittals
 - .1 Product Data: Provide product description, list of materials and thickness for each pipe section or equipment scheduled to be insulated.
 - .2 Shop Drawings: Include installation details for valves, fittings, pipe and all other items to be insulated.
- 1.3 Job Conditions

- .1 Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness.
 - .2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.
 - .3 Protect the insulation from dirt, water, chemical attack and mechanical damage before, during and after installation. Damaged or contaminated insulation should be discarded and removed from job site.
- 1.4 Acceptable Manufacturers:
- .1 Fibreglass Canada
 - .2 Knauf
 - .3 Manson
 - .4 Owens Corning
 - .5 Johns Manville
- 2 Products
- 2.1 General
- .1 Adhesives, Insulation, Coatings, Sealers and Recovering Jackets shall have composite fire and smoke hazard ratings not exceeding 25 for flame spread and 50 for smoke developed.
 - .2 Adhesives, coatings and sealers shall be waterproof.
 - .3 All accessories materials such as field installed jackets, mastics, coatings, tapes, fasteners shall be recommended by each component manufacturer for the specified application or as listed in the N.A.I.M.A. Guide to Insulating Chilled Water Systems with Mineral Fiber Pipe Insulation.
- 2.2 Materials
- .1 Preformed mineral fiber pipe insulation with factory applied all-service vapor-retarder jacket (A.S.J.) jacket shall have a flame spread rating not greater than 25 and a smoke developed rating not greater than 50 when tested as in accordance with A.S.T.M. E84, U.L. 723 or C.A.N./U.L.C. S102 (Canada).
 - .2 Preformed mineral fiber pipe insulation shall have a water vapor sorption of less than 5 percent by weight as tested in accordance A.S.T.M. C 547.
 - .3 All service jacket (A.S.J.) shall have a water vapor permeance of 0.02 perms or less as tested in accordance to A.S.T.M. E96, procedure "A".

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- .4 When a vapor mastic is required, a water vapor permeance of 0.02 per A.S.T.M. E-96 Procedure B must be achieved.
 - .5 Heating piping insulation shall be 38 millimeters (1.5 inches) thick for pipe diameters up to and including 32 millimeters (1-1/4 inches) and 50 millimeters (2 inches) thick for pipe diameters 38 millimeters (1-1/2 inches) and larger.
 - .6 Chilled water piping insulation shall be 25 millimeters (1.0 inch) thick for pipe diameters up to and including 150 millimeters (6 inches) and 38 millimeters (1.5 inches) thick for pipe diameters 200 millimeters (8 inches) and larger.
 - .7 Hydronic Piping, Exposed Vents: Fine fibrous glass insulation with factory applied vapour barrier jacket, molded to conform to piping, conductivity value at 0.25-0.29 b.t.u. per inch per square foot per degrees Fahrenheit per hour.
 - .8 Recovering Jackets, Indoor Exposed Finished Areas (i.e. Mechanical Rooms, Custodial Rooms, Storage Rooms, etcetera): P.V.C. pre-formed.
 - .9 Protective Jackets, Outdoor piping: minimum 0.4 millimeters (0.016 inches) aluminum jacket for insulation outside diameters. Aluminum jacketing shall conform to A.S.T.M. C1729. Secure to piping using S.S. banding.
- 3 Execution
- 3.1 Preparation
- .1 Do not install covering before piping and equipment has been tested and approved.
 - .2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.
- 3.2 Installation
- .1 In non fire rated surfaces, ensure insulation is continuous through inside walls. Pack around pipes with fireproof self-supporting insulation material, properly sealed.
 - .2 Finish insulation neatly at hangers, supports and other protrusions.
 - .3 Provide recovering jackets on exposed insulation as specified herein.
 - .4 Coat recovering jacket with two coats of waterproof fire retardant coating.
 - .5 Do not install and seal vapour proof insulation if ambient air has a high humidity.

- .6 **Pipe hangers shall wrap around outside of insulation for all sizes.**
Piping shall be provided with insulation flashing of heavy gauge metal to prevent crushing and hanger sized for exterior of insulation.
- .7 All pipe insulation longitudinal and circumferential joints must be sealed using the self-seal lap and butt strips. All self seal-laps and butt strips must be firmly rubbed with a sealing tool such as a squeegee to assure proper adhesion. The butt strip must be centered on the circumferential joint and the end of the strip should overlap itself by a minimum of 1 inch (25.4 millimeters).
- .8 Stapling of the A.S.J. jacket or self-sealing joints is prohibited.

3.3 Hydronic Piping

- .1 Insulate all new hydronic supply and return piping.
- .2 Insulate valves, unions, flanges, strainers, flexible connections and expansion joints for all cold water and hybrid water systems. Not required on hot water loop.
- .3 Cover elbows, tees and similar fittings with equivalent thickness of insulation material.
- .4 The outermost A.S.J. vapor retarder must have a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.
- .5 For chilled water piping, the butt end of every fourth pipe insulation section, and the ends or raw edges of insulation terminations at equipment connections, fittings and fire stop systems shall be sealed with vapor retarder mastic.
- .6 When a vapor retarder mastic is required, a maximum water vapor permeance of 0.02 per A.S.T.M. E-96 Procedure B must be achieved. Follow the mastic manufacturer's recommendations for application to achieve the 0.02 perm rating.
- .7 Vapor dams shall be used on all chilled water systems. Vapor dams or vapor seals shall be installed at every fourth section and at the termination of all fittings.
- .8 Install P.V.C. (indoor) or metal jacket (outdoors). P.V.C. or metal jackets are installed over factory applied A.S.J. jacket in order to provide abuse protection, cleanable surface or a specific appearance as required by the space or area of the installation. Overlap P.V.C. jacket at all joints with P.V.C. tape. Install metal jacket with overlap at all joints and secure using SS bands and seal as per manufacturer's instructions. Do not use screws or any fasteners which penetrate the jacket(s).

.8 Do not insulate within radiation enclosures, where applicable.

End of Section

1 General

1.1 Related Sections

- .1 Section 22 13 19 – Plumbing Drains
- .2 Section 22 42 00 – Plumbing Fixtures and Trim
- .3 Section 23 05 93 – Testing, Adjusting and Balancing for H.V.A.C.
- .4 Section 23 25 13 – Water Treatment
- .5 Section 22 10 00 – Plumbing Piping and Fittings
- .6 Section 23 21 00 – Pipe and Pipe Fittings

1.2 References

- .1 A.S.T.M. E202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 Cleaning and Start-up of Mechanical Piping Systems

- .1 In accordance with Section 23 25 13 – Water Treatment.

1.4 Hydronic Systems – Performance Verification (P.V.)

- .1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2 When systems are operation, perform following tests:
 - .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
 - .2 Verify performance of hydronic system circulating pumps as specified in relevant technical sections, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
 - .1 Pump operation.
 - .2 Water to Water Heat Pump (where applicable) operation.
 - .3 Zone Heat Pump (where applicable) operation.
 - .4 Radiant in-floor heating (where applicable) operation.
 - .5 Fan Coil (where applicable) operation.
 - .6 Unit Heater (where applicable) operation.
 - .7 Pressure by-pass open/closed.

- .8 Control pressure failure.
- .9 Maximum heating demand.
- .10 Maximum cooling demand (where applicable).
- .11 Water to water Heat Pump (where applicable) failure.
- .12 Zone Heat Pump (where applicable) failure.
- .13 Fan Coil (where applicable) failure.
- .14 Unit Heater (where applicable) failure.
- .15 Radiant in-floor heating (where applicable) failure.
- .16 Outdoor reset. Re-check heat exchanger output supply temperature at 100 percent and 50 percent reset, maximum water temperature.

1.5 Hydronic System Capacity Test

- .1 Timing: After:
 - .1 T.A.B. has been completed.
 - .2 Verification of operating, limit, safety controls.
 - .3 Verification of primary and secondary pump flow rates.
 - .4 Verification of accuracy of temperature and pressure sensors and gauges.
- .2 Calculate system capacity at test conditions.
- .3 Using manufacturer's published data and calculated capacity at test conditions extrapolate system capacity at design conditions.
- .4 When capacity test is completed, return controls and equipment status to normal operating conditions.
- .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
- .6 Heating system capacity test:
 - .1 Perform capacity test when ambient temperature is within 10 percent of design conditions. Simulate design conditions by:
 - .1 Increasing O.A. flow rates through heating coils (in this case, monitor heating coil discharge temperatures at all times to ensure that coils are not subjected to freezing conditions) or

- .2 Reducing space temperature by turning off heating system for sufficient period of time before stating testing.
- .2 Test procedures:
 - .1 Open fully heat exchanger, heating coil and radiation control valves.
 - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
 - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.
- .7 Cooling system capacity test (where applicable):
 - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
 - .1 Adding heat from building heating system or
 - .2 Raising space temperature by turning off cooling and air systems for sufficient period of time before starting testing and pre-heating building to summer design space temperature (occupied) or above. Set O.A.D. and R.A.D. for minimum outside air if O.A.T. is near outside design temperature or to maximum recirculation if R.A.T. is greater than O.A.T. R.A.T. to be at least 23 degrees Celsius.
 - .2 Test procedures:
 - .1 Open fully cooling coil control valves.
 - .2 Set thermostats on associated Air Handling Equipment for maximum cooling.
 - .3 Set air handling equipment for design maximum air flow rates.
 - .4 Set load or demand limiters on chillers to 100 percent.
 - .5 After system has stabilized, record chilled water, condenser water, etcetera, flow rates and supply and return temperatures simultaneously.

1.6 Glycol Systems

- .1 Test to prove concentration will prevent freezing to minus 40 degrees Celsius. Test inhibitor strength and include in procedural report. Refer to A.S.T.M. E202.

1.7 Potable Water Systems

- .1 When cleaning is completed and system filled:
 - .1 Verify performance of equipment and systems as specified elsewhere in mechanical Division.
 - .2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor. Repeat for each outlet and flush valve.
 - .3 Confirm water quality consistent with supply standards, verifying tat no residuals remain as a result of flushing and/or cleaning.

1.8 Wet and Dry Pipe Sprinkler System, Standpipe and hose Systems (where applicable)

- .1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in other mechanical Divisions.
- .2 Verification of controls, detection devices, alarm devices is specified in other mechanical and electrical Divisions.
- .3 Demonstrate that fire hose will reach to most remote location regardless of partitions, obstructions, etcetera.
- .4 Verify operation of interlocks between H.V.A.C. systems and fire alarm systems

1.9 Sanitary and Storm Drainage Systems

- .1 Buried systems: Perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.
- .2 Ensure that traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system.
- .4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.
- .5 Cleanouts: Refer to Section 22 13 19 – Plumbing Drains.
- .6 Roof Drains:
 - .1 Refer to Section 22 13 19 – Plumbing Drains.
 - .2 Remove caps as required.
- .7 Floor Drains and Area Drains:

- .1 Refer to Section 22 13 19 – Plumbing Drains.
- .2 Remove strainer as required.

1.10 Reports

- .1 In accordance with Section 21 13 13, 22 05 01 and 23 05 01.

2 Products

Not applicable.

3 Execution

Not applicable.

End of Section

1 General

1.1 Summary

.1 Section includes:

- .1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.2 Related Sections

- .1 Section 23 05 93 – Testing, Adjusting and Balancing
- .2 Section 23 25 13 – Water Treatment

1.3 References

- .1 American Society of Testing and Materials International (A.S.T.M.)
 - .1 A.S.T.M. E202 – Standard Test Methods for analysis of Ethylene Glycols and Propylene Glycols.
 - .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (M.S.D.S.)

1.4 Submittals

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 22 05 01 and 23 05 01. Include product characteristics, performance criteria, and limitations.

1.5 Quality Assurance

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 – Health and Safety Requirements.

1.6 Delivery, Storage, and Handling

- .1 Packing, shipping, handling and unloading.
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01.
- .2 Waste management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: Separate waste materials for reuse and recycling in accordance with Section 01.

2 Products

2.1 Cleaning Solutions

- .1 Low foaming detergent at all temperatures.
- .2 No p.H. neutralization required
- .3 Designed for use on most metals including aluminum.
- .4 Bio-degradable.
- .5 Phosphate Free.
- .6 Nitrite Free.

3 Execution

3.1 Cleaning Hydronic and Steam (where applicable) Systems

- .1 Timing
 - .1 Systems to be operational, hydrostatically tested and with safety devices functional before cleaning is carried out.
- .2 Cleaning Agency:
 - .1 Retain qualified water treatment specialist to perform system cleaning.
- .3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.
- .4 Cleaning procedures:
 - .1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
 - .1 Cleaning procedures, flow rates, elapsed time.
 - .2 Chemicals and concentrations to be used.
 - .3 Inhibitors and concentrations.
 - .4 Specific requirements for completion of work.
 - .5 Special precautions for protecting piping system materials and components.
 - .6 Complete analysis of water to be used to ensure water will not damage systems or equipment.
- .5 Conditions at time of cleaning systems

- .1 Systems to be free from construction debris, dirt and other foreign material.
- .2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.
- .3 Strainers to be clean prior to initial fill.
- .4 Install temporary filters on pumps not equipped with permanent filters.
- .5 Install pressure gauges on strainers to detect plugging.
- .6 Report on Completion of Cleaning
 - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Hydronic Systems:
 - .1 Flush system thoroughly with water, back flush pump, strainers, blow down drain valves and risers to removal all loose debris. Remove accumulated sludge in boilers if necessary.
 - .2 Then add 2 percent solution of low foaming detergent to the system through a by-pass feeder or another feeding device.
 - .3 Circulate for 36 hours at 82 degrees Celsius. For chilled systems, circulate at least 48 hours at ambient temperature.
 - .4 During recirculation, back flush strainers, drain valves and risers at their lowest point once every 8 hours.
 - .5 Drain cleaning water completely.
 - .6 Then fill and drain system several times. Circulate 30 minutes every time the system is refilled.
 - .7 Bleed system at several points until water is clear and non-foaming. Clean pump strainers.
 - .8 Draw a water sample from the system and sent it out to laboratory for analysis.
 - .9 If the laboratory report is satisfactory, the system must then be treated with the appropriate formula.
- .8 Glycol Systems:
 - .1 In addition to procedures specified above perform procedures specified herein.

- .2 Test to prove concentration will prevent freezing to minus 40 degrees Celsius. Test inhibitor strength and include in procedural report. Refer to A.S.T.M. E202.

3.2 Start-up of Hydronic Systems

- .1 After cleaning is completed and system is filled:
 - .1 Establish circulation and expansion tank level, set pressure controls.
 - .2 Ensure air is removed.
 - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
 - .4 Dismantle system pumps used for cleaning, inspect, replace work parts, install new gaskets and new set of seals.
 - .5 Clean out strainers repeatedly until system is clean.
 - .6 Commission water treatment systems as specified in Section 23 25 13 – H.V.A.C. Water Treatment.
 - .7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
 - .8 Repeat with water at design temperature.
 - .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
 - .10 Bring system up to design temperature and pressure slowly over a 48 hour period.
 - .11 Perform T.A.B. as specified in Section 23 05 93 – Testing, Adjusting and Balancing (T.A.B.).
 - .12 Adjust pipe supports, hangers, springs as necessary.
 - .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
 - .14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
 - .15 Re-tighten bolts, etc., using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
 - .16 Check operation of drain valves.

- .17 Adjust valve stem packings as systems settle down.
- .18 Fully open all balancing valves (except those that are factory-set).
- .19 Check operation of over-temperature protection devices on circulating pumps.
- .20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.3 Cleaning

- .1 Provide in accordance with Division 1.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

End of Section

1 General

1.1 Costs

- .1 The Controls contractor described herein shall be carried by the mechanical contractor and included with their tender price.

1.2 General

- .1 The work shall include design, supply, installation, and commissioning a complete microprocessor based automatic control system to achieve the performance specified in the following clauses.
- .2 The control system shall be installed by the control subcontractor. The system shall be installed by trade certified electricians regularly employed by the control sub-contractor.
- .4 The controls contractor will specifically read all mechanical and electrical drawings, specifications, and addenda and determine the controls work provided by the mechanical contractor, his subcontractors, and the electrical contractor. The controls contractor is expected to have the expertise to coordinate the work of other contractors and to make a completely coordinated Building Automation System (B.A.S.) for the mechanical systems. The controls specifications are specifically written to coordinate the mechanical and electrical systems. Where others are specifically specified to allow for controls work, then the B.A.S. contractor will not allow for that work. This clause is not intended to make the controls contractor responsible for work not specified, but to make the BAS contractor responsible for examining the specifications for contradictions and overlap.
- .5 All work indicated in the plumbing drawings and associated with the plumbing systems will be the responsibility of the mechanical contractor unless specifically indicated in the controls sequence of operation or points list.
- .6 The BAS contractor shall provide the necessary engineering, installation, supervision, commissioning and programming for a complete and fully operational system. The contractor will provide as many trips to the job site for installation, supervision, and commissioning as are necessary to complete the project to the satisfaction of the consultant and/or Building project supervisor.
- .7 The system shall consist of all operator interfaces, microprocessor-based controllers, sensors, wells, automatic control valves, control dampers, transducers, and relays, automatic control valves, and damper actuators.
- .8 The system components shall be listed by Underwriters Laboratories Incorporated and Canadian Standards Association.

1.3 Scope

- .1 This project scope shall include, but not be limited to, the following work:
 - .1 Preparation of control shop drawings for review and approval. See *Submittals*.
 - .2 Supply and install a network of Direct Digital Control (D.D.C.) panels and field devices. See *Hardware, Software and Field Devices*
 - .3 Supply and install customized graphics software to Building standards, system software, and third party software as specified. See *Software*
 - .4 Install, wire and label all D.D.C. control system components. See *Installation*.
 - .5 Calibrate and commission the installed control system. Controls contractor shall be present during the start-up and commissioning of all Mechanical Equipment associated or connected to the B.A.S.
 - .6 Provide maintenance manuals and as-built drawings. See *As-Built Documentation*.
 - .7 Provide customized training for Building operations, maintenance and technical staff. See *Training*.
 - .8 Provide a one-year on site parts and labour warranty on all components. See *Warranty*.

1.4 Associated Work Specified in Other Sections

- .1 The contractor shall coordinate the installation of devices furnished in this section with the installing contractor by trade jurisdiction.
- .2 Heating Contractor
 - .1 Install all control valves, temperature sensors and flow meters as supplied by the Controls Contractor.
 - .2 Supply and install other valves, flanges, union fittings, pressure taps, shutoff cocks, flow switches, immersion wells, thermometers, and similar items as required for the system and/or as indicated on the drawings.
 - .2 Supply and installation of access panels for service and installation of control equipment.
- .3 Sheet Metal/Ventilation Contractor

- .1 Install all single and multiple section dampers, interconnecting linkages, blank-off plates, duct transitions, access doors, louvers and similar items as required for the system and/or as indicated on the drawings.
 - .2 Supply and installation of sheet metal baffles as required to eliminate air stratification.
 - .3 Supply and installation of access panels for service and installation of control equipment.
 - .4 Division 26 – Electrical Contractor
 - .1 Install and connect electrical power to all motors, transformers, starters as indicated on schedules, and D.D.C. System control panels.
- 1.5 Submittals
- .1 Submit the following shop drawings in electronic format to the Consultant for review prior to ordering or installation:
 - .1 Control Schematics
 - .2 Detailed sequence of operation for each control schematic or controlled system.
 - .3 System Architecture indicating the proposed interconnection and location of all B.A.S. panels, network connections and key peripheral devices (workstations, modems, printers, repeaters, etcetera)
 - .4 BAS Points List indicating the panel I.D., panel location, hardware address, point acronym, point description, field device type, point type (i.e., A.O./D.O./A.I./D.I.), end device fail position, end device manufacture and model number, and wire tag I.D.).
 - .5 Wiring diagrams including complete power system, interlocks, control and data communications.
 - .6 Manufacturers' data/specification sheets for all material supplied.
 - .2 Submit required number of copies of the following Operation and Maintenance Data for inclusion in the maintenance manuals:
 - .1 Operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.

- .2 "As Built" drawings, including plan layout, conduit runs, interconnection between devices, and panel wiring diagrams as finally installed.
- .3 A complete application description, address location, sequence of operation and I/O summary for each controller installed in the system.
- .4 A complete program manual containing all information necessary to operate the software and man-machine interface devices in the system and to program all controllers and interface devices installed in the system.
- .5 Manufacturer application manuals, if available, for each controller in the system.

1.6 Warranty

- .1 The system and all manufacturer and contractor supplied components, parts and assemblies shall be guaranteed against defects in material and workmanship, under normal use, for twelve months after start-up and written acceptance of the system by the owner. The contractor shall provide warranty service.
- .2 The contractor shall have a local office staffed with trained, full-time employees who can perform testing, inspection, repair and maintenance services for the system.

1.7 Acceptable Manufacturers:

- .1 Reliable Controls (BACnet) system hardware, as supplied and installed by a Reliable authorized dealer.

2 Products

2.1 Network Architecture

- .1 Provide new B.A.S. network utilizing the manufacturer recommended network architecture and conforming to requirements of A.N.S.I./A.S.H.R.A.E. Standard 135-1995.

2.2 Product Description

- .1 The D.D.C. System shall utilize and integrate the operation of intelligent Building Management and Unitary D.D.C. Controllers (U.C.s) distributed on the BACnet network.
- .2 Each control unit shall include its own microcomputer direct digital controller and execute the application specific programs, calculations, and commands to provide the control function specified for that unit.

- .3 Controllers shall be capable of full control functionality and alarm reporting independently or as a part of the D.D.C. network.
- .4 Each controller shall be able to transfer and receive data via the network for performance of control functions.
- .5 The D.D.C. System shall be comprised of any or all of the following devices to achieve the control functions described in this section:
 - .1 Building Management controllers are general building management controllers designed to control H.V.A.C. equipment and devices via program loops and start/stop control for electrical loads and electrical demand limiting. The Building Management Controller shall also serve as the Network master with Real-time clock control, Weekly, holiday and temporary schedules, Alarming, Trending and logging, and supervision of the E-Bus network.
 - .2 Unitary D.D.C. Controllers (U.C.'s): provide new controllers as required to control new Ventilation and Hydronic Systems designed to control specific equipment.

2.3 Building Management Controller WEB BASED CONTROLLER

- .1 Building Manager to include new controls.
- .2 Unitary D.D.C. Controllers
 - .1 Controls shall be microprocessor based Interoperable BACnet Controllers (.I.B.C.) in accordance with the A.N.S.I./A.S.H.R.A.E. Standard 135-1995. I.B.C.'s shall be provided for Room Control and other applications as shown on the drawings. The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals. The system supplier must provide a P.I.C.S. document showing the installed systems compliance level to the A.N.S.I./A.S.H.R.A.E. Standard 135-1995, to the Controls Contractor.
 - .2 The I.B.C.'s shall communicate with the N.A.C. via an Ethernet connection at a baud rate of not less than 10 megabits per second or via the RS485 connection at a baud rate of not less than 38 kilobits.
 - .3 The I.B.C. Sensor shall connect directly to the I.B.C. and shall not utilize any of the I/O points of the controller. The I.B.C. Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive. The I.B.C. Sensor shall provide a communications jack for connection to the BACnet communication trunk to which the I.B.C. controller is connected. The I.B.C. Sensor, the connected controller, and all other devices on the BACnet bus shall be accessible by the P.O.T.

- .4 All I.B.C.s shall be fully application programmable and shall at all times maintain their BACnet Level 3 compliance. Controllers offering application selection only (non-programmable), require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the I.B.C. shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
- .5 The Controls Contractor supplying the I.B.C.'s shall provide documentation for each device, with the following information at a minimum:
 - .1 BACnet Device; MAC address, name, type and instance number
 - .2 BACnet Objects; name, type and instance number
- .6 It is the responsibility of the Controls Contractor to ensure that the proper BACnet objects are provided in each I.B.C., as required by the point charts.

2.4 Operator Interface

- .1 Provide new operator interface and new controllers and system components shall integrate and communicate with it.

2.5 Alarms

- .1 Alarms shall be generated when system failures, H.V.A.C. equipment failures, or sensor failures are detected. Alarms shall be immediately displayed on the Keyboard Display Module connected to the controller. When an alarm is present, the display shall show an alarm indicator and a separate display that shows the alarm description shall alternate on the display along with the normal run screen that shows the time and date. If an alarm is encountered, it may be acknowledged through the Keyboard Display Module. Alarms shall also be reported to the network and be used to initiate a dial-out via the Network Interface Unit based on dial-out priority.
- .2 Building management and Unitary D.D.C. Controllers (U.C.s)s shall be capable of having a digital output assigned to initiate a local annunciation of an alarm using a buzzer or alarm light when the associated controller experiences any alarm condition.
- .3 Alarm conditions include analog excursions beyond specific programmable setpoints (nominal), sensed digital input shorts and closures (digital inputs), and analog excursions outside a range of a changing program setpoint (setpoint) for intelligent recovery and reset functions.
- .4 Nominal alarming shall monitor an analog sensor, compare it to upper and lower alarm values, and initiate an alarm if the sensed value is greater than the upper value or less than the lower value.

- .5 Setpoint alarming shall monitor the setpoint, and compare it to the sensor that is providing input to the controller. A low (heating, reverse acting) alarm value shall be used for the comparison. If the control sensor value is below the setpoint for a heating or reverse acting control loop, an alarm shall be registered.

2.6 Field Devices

- .1 The D.D.C. System shall utilize and integrate the operation of intelligent Building Management and Unitary D.D.C. Controllers (UCs) distributed on the BACnet network.
- .2 All electric switch devices shall be selected for the applied load and UL listed and labeled for the application and environment to which they are applied
- .3 All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with direct-coupled electric actuators sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close off
- .4 Control Valves
 - .1 The Controls Contractor shall supply the automatic control valves and actuators. Control valves 2 inches and smaller shall be screwed type, and valves 2-1/2" inches and larger shall be flanged. Valves shall be ANSI-rated to withstand the pressures and temperatures encountered. Valves shall have stainless-steel stems and spring loaded Teflon packaging with replaceable discs. Valves (less actuators) shall be turned over to the H.V.A.C. Contractor for installation. The Controls Contractor shall install the actuator.
 - .2 All modulating straight-through water valves shall be provided with equal-percentage contoured throttling plugs. All three-way valves shall be provided with linear throttling plugs such that the total flow through the valve shall remain constant regardless of the valve's position.
 - .3 Valves shall be sized as follows:
 - .1 Two-Position: Line size or size using a pressure differential of 1psi.
 - .2 Terminal Units: Pressure drop not to exceed 2 psig.
 - .3 Major Equipment (AHU): Pressure drop not to exceed 4 psig.
 - .4 Unitary valves shall be straight-through or three-way type as shown on the drawings. Stems shall be polished stainless steel and packing shall be ethylene-propylene suitable for both chilled water and 250

- degree hot water service. Pressure ratings shall be as required for the intended service.
- .5 Submit a valve schedule for all valves supplied under this contract. The valve schedule will contain the following information for each valve:
 - .1 Valve size, connection type, line size, valve manufacturer and model number, valve flow coefficient, design flow, pressure drop across valve, max. close-off pressure, actuator manufacturer and model number, actuator max. torque.
 - .2 Valves used for throttling applications shall be globe-type valves with an equal percentage plug characteristic for 1-inch sizes and above.
 - .5 Control Valve Actuators
 - .1 Size control valve actuators to provide a tight close off against system head pressures and pressure differentials.
 - .2 Valve actuators shall accept a 0-10VDC control voltage for all proportional applications.
 - .6 Control Dampers
 - .1 Control Dampers shall be supplied and installed by the Mechanical Contractor.
 - .7 Control Damper Actuators
 - .1 Actuators shall be direct coupled for either modulating or two position control. Actuators shall be powered by an overload-proof synchronous motor. Provide 0-10 VDC control voltage for all proportional applications and either line or low voltage actuators for all two position applications. Floating point control shall be acceptable for air terminal units only.
 - .2 Damper actuators are to be manufactured by Belimo.
 - .8 Room Sensors/Thermostats
 - .1 Mount sensors at a height of 1,200mm unless otherwise indicated.
 - .2 10 k ohm thermistors only shall be used and shall have end-to-end accuracy +/- 0.3 degC over the entire operating range.
 - .3 Provide a guard or cage for all sensors or thermostats mounted in public areas such as stairways, vestibules, lobbies. On the approval of the Engineer, provide a flush-mounted stainless steel sensor in lieu of guard or cage.

- .9 Occupancy Sensors
 - .1 Occupancy sensors shall be ceiling mounted Paradox 360. Occupancy sensors shall tie into the Controller for control of the heating and ventilation as indicated on the schematics.
- .10 Current Sensor (Analog)
 - .1 Technical Performance – Output shall be 4-20mA only. End-to-end accuracy +/- 2% of full scale at each range.
- .11 Duct Mounted Humidity Sensor
 - .1 Technical Performance - Operating range from 10% - 90% over 0-60 degC temperature range. End-to-end accuracy of +/- 1% of operating range, with maximum temperature dependence of 0.2% per degC change. 200mm long probe, with enclosure for mounting in duct. 4-20mA output only. Voltage output is not acceptable.
- .12 Duct Temperature Sensor
 - .1 Probe - Technical Performance – 10 k ohm thermistor sensor encapsulated in a 200mm long, 6mm OD copper or stainless steel probe. Operating range 0-60 degrees C. End-to-end accuracy +/- 0.3 degC. Assembly complete with wiring housing and mounting flange.
 - .2 Averaging - Technical Performance - 10 k ohm thermistor constructed of FT6 plenum rated cable or soft copper tubing, incorporating numerous temperature sensors encapsulated at equal distances along the length of the element. The assembly acts as a single sensor reporting the average temperature from all individual sensors. End-to-end accuracy +/- 0.3 degC. Assembly complete with wiring housing and mounting flange. Mount in a zig-zag manner to provide continuous coverage of the entire duct cross-sectional area.
- .13 Outdoor Air Temperature Sensor
 - .1 Technical Performance, 10 k ohm thermistor -50C to 50C in a weatherproof enclosure, sun shield and mounting bracket. End accuracy of +/- 0.3 degC over the entire operating range.
- .14 Pipe Temperature Sensor
 - .1 Well - Technical Performance - 10k ohm thermistor sensor encapsulated in a 6mm OD, 50mm long probe, with screw fitting for insertion into a standard thermowell. Operating range -10 - +100 degrees C. End-to-end accuracy +/- 0.3 degC over the entire operating range. Comes complete with brass thermowell. Use conductive gel when mounting the sensor in thermowell. No surface

mount strap on temperature sensors shall be used to monitor fluid temperature unless approved by the engineer.

.15 Duct Carbon Dioxide (CO₂) Sensor

- .1 Technical Performance – A stand-alone carbon dioxide (CO₂) sensor with one analog output. Operating Temperature: +32°F to +122°F (0°C to +50°C). Relative Humidity (non-condensing): 0 to 95 percent. Power Supply: 24 Vac ±20%, 50/60 Hz (Class 2). Output: Analog: 0-10 Vdc, suitable for application. Response Time: 1 min.
- .2 Carbon Dioxide Sensor: Operation: Non-dispersive infrared (NDIR). Sampling: Diffusion. Range: suitable for application. Annual Drift: ±10 ppm (nominal). Accuracy: ±(30 ppm+2%) at normal temperature/pressure.

2.7 Alarm Logging and Remote Reporting

- .1 All new alarms shall be logged and reported as per CoP standards.

3 EXECUTION

3.1 Examination

- .1 Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
- .2 Review drawings to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
- .3 Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate Section 23 09 23 work with work of others. Controls Contractor shall perform at their expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 Scope of Work

- .1 Controls Contractor shall provide all necessary control valves, room controllers, temperature sensors, control panels, installation labor, programming, commissioning, graphics generation and training as required for a new, complete, and operational controls system.

3.3 Power Sources and Wiring Methods

- .1 All line and low voltage wiring shall be installed in EMT conduit unless specifically specified otherwise. EMT shall be used in all mechanical rooms, service rooms, and any exposed spaces.
- .2 In accessible ceilings with cable trays, control system network and low voltage wiring only may be installed with plenum rated cable (FT6) in cable tray. Wiring in cable tray shall be grouped separately from other wiring (Comm/Data/PA).
- .3 BX shall only be used for the final (approximately 3') run to controls devices. Liquidtight shall be used in all exposed areas and exterior areas for final connection.
- .4 Install EMT and cable at right angles to building lines, securely fastened, and in accordance with the standards set out in Division 26.
- .5 All wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals.
- .6 No wire smaller than 18 gauge wire is to be used on the project except for: wiring between terminal computer devices, wire in standard communication cables, such as printers and short haul modems, wire used in communication networks, i.e. any cable transferring digital data, using twisted shielded pairs.
- .7 Wiring from panels to devices shall be without splicing.
- .8 Provide wells for all specified temperature sensors in hydronic piping system. Strap-on sensors may be only be used where a well installation is not possible. Obtain approval of Engineer for the use of strap-on sensors.
- .9 Power for control system shall not be obtained by tapping into miscellaneous circuits that could be inadvertently switched off.
- .10 Mount transformers and other peripheral equipment in panels located in serviceable areas. Provide line side breakers/fuses for all transformers.
- .11 All 120 VAC power for any controls equipment shall be from dedicated circuits. Update the panel circuit directory.
- .12 The controller may be powered from the equipment that it is directly controlling (i.e. heat pump, roof-top unit) only if the controller controls no

other equipment and the power supply to the controller remains energized independently of unit operation or status.

- .13 All D.D.C. control panels shall be provided with in line surge protection.
- .14 Controls shall be fed through base of roof mounted equipment wherever possible. Where not possible supply 90 degree pitch pocket and coordinate roofing with General Contractor. Seal end of pitch pocket after feeder is installed.

3.4 Equipment Location

- .1 All distributed equipment such as VAV boxes, Roof top units, unit ventilators, fan coil units, etc. that utilize dedicated D.D.C. controllers, shall have locally mounted controllers, in accessible locations. All locally mounted controllers shall be installed in enclosures suitable for that location. D.D.C. controllers for mechanical equipment other than those listed above shall be mounted in mechanical rooms as noted below, unless specifically approved by the Engineer for this project.
- .2 All other D.D.C. controllers, and interface devices that require regular inspection or that serve multiple H.V.A.C. systems shall be located in mechanical rooms, or in pre-approved storage rooms, or janitor closets.
- .3 All equipment located in mechanical rooms, storage rooms or janitor closets shall be installed in metal cabinets with hinged, lockable covers. Provide a Building-standard key/lock set for each cabinet. Cabinets shall contain the following:
 - .1 All transformers and power supplies for equipment located within the cabinet. (No control transformers or power supplies shall be located in ceiling spaces).
 - .2 Line filters for all power, supplying control equipment within the cabinet.
 - .3 P.C. access port to log onto the D.D.C. system.
 - .4 120 V.A.C. duplex receptacle for portable PC power, if the cabinet is located further than 5' laterally from the nearest outlet.

3.5 Identification and Labeling of Equipment

- .1 All panels must have a lamicoid tag (minimum 3 inches by 2 inches) affixed to the front face indicating panel designation and function (i.e. "B.A.S. Panel 1" or "Relay Panel 3"). Lamacoids shall be mechanically fastened to panels.
- .2 Identify all control components with brass tag and chain.

- .3 All wires will be identified with band-type self-adhesive strips or clip-on plastic wire markers at both ends.
- .4 If a phone line manager is supplied, its location should be indicated via a label affixed to the inside cover of the modem enclosure or B.A.S. panel.
- .5 All B.A.S. panels will have a points list sheet (within a plastic sleeve) attached to the inside door. The points list will identify the following for each point: Panel number, panel location, hardware address, software name, point description, field device type, point type (i.e. A.I. or D.O.), device fail position, device manufacturer and model number or reference and wire tag reference.
- .6 Where required, field panels will have wiring diagrams attached to the inside door.
- .7 Provide new equipment wiring diagrams (i.e. boilers, chillers, etcetera) wherever the B.A.S. interfaces to other equipment.

3.6 Commissioning

- .1 Confirm and demonstrate to the Engineer and that that all systems are programmed and operating correctly. Demonstrate a minimum of 30 percent of readings and submit on separate test forms.
- .2 Controls Contractor shall be present for the start-up and commissioning of all Mechanical Equipment associated with or connected to the B.A.S.
- .3 Submit electronic copies of the system commissioning report to the Engineer for review and approval.
- .4 Each analog input (i.e. temperatures, pressure, etcetera) shall be verified with an approved calibration device. All actual temperature readings should be with +/- 1 Celsius of the readings observed at the workstation.
- .5 Each analog output shall be verified by manually commanding the output channel from the operator workstation to two or more positions within the 0-100 percent range and verifying the actual position of the actuator or device. All devices shall operate over their entire 0-100 percent range from a minimum control range of 10-90 percent
- .6 Digital outputs shall be verified by witnessing the actual start/stop operation of the equipment under control.
- .7 Digital inputs shall be verified by observing the status of the input point as the equipment is manually cycled on and off.
- .8 Record all out-of-season or unverified points in the commissioning report as "uncommissioned".

- .9 The B.A.S. field panel power source shall be toggled on and off to ensure reboot functionality and power down memory retention of all parameters. During the power down test, all connected system components should go to their fail-safe state.
- .10 All trends should be reviewed to ensure that setpoints are being maintained and excessive cycling of equipment is not occurring.
- .11 Control loop tuning parameters can be verified by applying a change to the current setpoint and observing the resulting trend log. Setpoint should be reached in a "reasonable" period of time without excessive cycling or hunting of the controlled device.

3.7 Training

- .1 All training shall be by the B.A.S. contractor and shall utilize operator's manuals and as-built documentation.
- .2 Operator training shall include four (4) separate four (4) hour sessions as decided by the Owner, encompassing modifying text and graphics, sequence of operation review, selection of all displays and reports, use of all specified OWS functions, use of Portable Operators Terminals, troubleshooting of sensors (determining bad sensors), and password assignment and modification.
- .3 The Owner may use the training sessions anytime within forty-five days after system completion to suit their needs.

3.8 As-Built Documentation

- .1 Within two weeks following substantial completion of the project, update the original submittal documents to reflect the "As Built" conditions of the project and submit as many copies as are required by the consultant and/or the Building Project Supervisor.
- .2 Submit (2) printed copies of the final programs that include all point definitions, weekly and annual schedule setting, controller setpoints and tuning parameters, and documented programmed sequences of operation.

4 Sequence of Operation

- 4.1 Sequences of Operation to be coordinated between Consultant and Controls Contractor at a later date.

End of Section

1 General

1.1 Welding

- .1 Welding materials and labour shall conform to A.S.M.E. Code and the provincial Regulations.
- .2 Use welders fully qualified and licensed by Provincial Authorities.

1.2 Quality Assurance

- .1 Gas piping shall meet the requirements of the latest C.S.A. Gas Installation Code.
- .2 Water piping shall meet the requirements of the Ontario Building Code and Municipal Codes.
- .3 Pipe fittings shall conform to the following standards:
 - .1 A.N.S.I. B36.10, A.S.T.M.-197-47 (Materials)
 - .2 A.N.S.I. B16.24, A.N.S.I./A.S.M.E. B16.15, A.N.S.I. B16.8, A.N.S.I./A.S.M.E. B16.22 (Copper Fittings)
 - .3 A.N.S.I. B16.3 (Malleable Iron Fittings, Threaded)
 - .4 A.N.S.I. B16.9 (Wrought Carbon Steel Fittings, Butt Weld)
 - .5 A.N.S.I. B16.5 (Forged Carbon Steel Flanges, Threaded, Weld Neck or Slip-on)
 - .6 A.N.S.I. B18.2.1 (Carbon Steel Bolts, Hex Head, Course Thread)
 - .7 A.N.S.I. B18.2.2 (Carbon Steel Nuts, Heavy Hex, Course Thread)
 - .8 A.N.S.I. B16.20 (Gaskets)
 - .9 A.N.S.I. B16.39 (Unions)
 - .10 C.S.A. B242-05 (R2016) (Groove and Shoulder Type Mechanical Pipe Couplings)

1.3 Reference Standards and Codes

- .1 Ontario Building Code
- .2 A.S.T.M.
- .3 C.S.A.
- .4 C.G.A.
- .5 A.N.S.I.
- .6 NFPA

- .7 U.L.C.
- .8 Local Codes and Requirements
- 1.4 Shop Drawings
 - .1 Submit shop drawings for Expansion Loops.
- 2 Products
 - 2.1 Hydronic Piping
 - .1 Piping up to and including 2 inches: Piping shall be Black Steel Schedule 40 with malleable steel threaded screwed fittings.
 - .2 Piping 2½ inches and over: Piping shall be Black Steel Schedule 40 with welded fittings.
 - .3 Brass adapters shall be provided at all connections between copper tubing and ferrous piping.
 - .4 Provide expansion loops in piping systems as indicated on drawings and specified herein.
 - .5 Refer to Section 23 83 16 for underground and in-slab piping serving walkway snow melting system.
 - 2.2 Expansion Loops
 - .1 Provide expansion loops equal to Flex Hose Tri-Flex Loop Model TFL4 (+/-4 inches axial), which provides a flexible pipe loop that will absorb and compensate multi-plane movements simultaneously as well as reduce piping stress.
 - .2 Construction to be 3 equal length sections of annular corrugated stainless steel close-pitch hose with stainless steel overbraid that will absorb or compensate for pipe movements in all 6 degrees of freedom (3 coordinate axes, plus rotation about those axes) simultaneously.
 - .3 The corrugated metal hose, braids, and a stainless steel ring-ferrule/band (material gauge not less than .048 inches) must be integrally seal-welded using a 100 percent circumferential, full penetration T.I.G. welds. End fittings shall be selected per application. Fittings must be attached using a 100 percent circumferential T.I.G. weld.
 - .4 Braided stainless steel Tri-Flex Loops must be suitable for operating temperatures up to 850 degrees Fahrenheit (455 degrees Celsius).

- .5 Expansion Loops shall be designed for pressure testing to 1.5 times their maximum rated working pressure and a minimum 4:1 (burst to working) safety factor.
- .6 Each braided expansion loop shall be individually leak tested by the manufacturer using air-under-water or hydrostatic pressure.
- .7 Expansion Loops shall be prepared for shipment using a cut-to-length metal shipping bar, tacked securely between the elbows of the two parallel legs, to maintain the manufactured length during shipping. Shipping bar must be removed prior to system start-up.
- .8 The hanger assembly kit shall be used to support and hang the expansion loop.
- .9 The U.L.C. Listed Seismic Wire/Cable assemblies conform to the requirements of the A.S.C.E. (American Society of Civil Engineers) guidelines for structural applications of wire rope, in that the cable is pre-stretched and the permanent end fittings maintain the break strength of the cable with a safety factor of two.
- .10 The pre-manufactured flexible loop shall be installed as per manufacturer's printed installation instructions. Other manufactured loops that require pipe alignment guides shall use "Spider" type with outer housing ring. Units shall be fabricated from carbon steel. Pipe hangers and/or roller supports shall not be considered acceptable for use as guides.
- .11 Expansion loops must have a 5-year full product replacement warranty.

2.3 Condensate Piping

- .1 Black Steel Schedule 40 with malleable steel threaded screwed fittings or
- .2 Type K. or L. hard copper complete with cast brass or wrought copper drainage fittings with solder joints or
- .3 IPEX X.F.R.

2.4 Gas Piping

- .1 Sizes 50 millimeters (2 inches) and under: A.S.T.M. A53 Schedule 40 seamless wrought steel with standard threaded malleable fittings to A.N.S.I. B16.3.
- .2 Sizes over 50 millimeters (2 inches): A.S.T.M. A53 Schedule 40 seamless wrought steel with wrought steel butt welding fittings to A.N.S.I. B16.9.
- .3 Welding materials and labour shall conform to A.S.M.E. codes and authorities having jurisdiction.

2.5 Refrigeration Piping

- .1 Refer to Section 23 23 00.

2.6 Equipment Drains (except boiler breeching drains)

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

2.7 Boiler Breeching Drains

- .1 C.P.V.C. meeting C.A.N./C.S.A.-B181.2, complete with neutralizer.

2.8 Connections

.1 Unions

- .1 Use extra heavy duty pattern unions with ground joints, brass seats and threads to A.N.S.I. B1.20.1 for connections 50 millimeters (2 inches) and under.
- .2 Rated for minimum 150 psi.

.2 Flanges

- .1 Use standard weight type flanges to A.N.S.I. B16.1 with neoprene gaskets for connections 63 millimeters (2½ inches) and over.
- .2 Rated for minimum 125 p.s.i.

.3 Adapters

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

2.9 Firestop Sealants and Collars

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

2.10 Glycol

- .1 Supply all glycol required for the hydronic system. Glycol shall be 50% propylene. Refer to Section 23 25 00 – Chemical Treatment.

3 Execution

3.1 General

- .1 Apply for permit before beginning any work. Have drawings approved for construction by authorities having jurisdiction or local agencies prior to beginning work.
- .2 Review all inverts and elevations before beginning any installation.
- .3 Pipe fittings for pipe up to and including 2 inches shall be malleable steel threaded. Pipe fittings for pipe 2½ inches and over shall be welded (grooved fittings are not acceptable).
- .4 Have entire installation inspected, at various stages where required, to ensure approval at completion of project.
- .5 Provide clearance for proper installation of insulation and for access to components including but not limited to valves, air vents, drains and unions.
- .6 Maintain proper grades on piping for proper drainage and provide valves at all low points.
- .7 All exposed piping to run parallel to walls and in a neat and orderly fashion to maintain headroom. Group piping where possible.
- .8 Do not run combustible or non-approved pipe through fire separations or return air ceiling plenums. Use approved materials and methods only.
- .9 Provide drain valves and air vents at low and high points respectively where required.
- .10 All gas piping installations shall comply with C.G.A. code C.A.N. 1-B149, gas safety branch bulletins, local codes and N.F.P.A. 96. Provide a C.G.A. approved ball valve where new equipment is to be connected.
- .11 Install gas piping in open or ventilated spaces. Pitch lines and provide drip legs for condensation collection points. Where gas piping is run in a concealed space, provide ventilation grilles as required.
- .12 Make connections to equipment with unions or flanges. Provide dielectric unions or couplings at all connections between copper tubing and ferrous piping or non-conducting type connections for jointing dissimilar metals.
- .13 Install piping to allow for expansion and contraction and to eliminate stress on equipment, piping, or connections.

- .14 Provide isolation valves or shutoff valves at all equipment.
- .15 Provide cleanouts as indicated on drawings and as required by code. Floor cleanouts are not approved in finished floor areas unless otherwise noted. Ensure adequate clearance to all cleanouts.
- .16 Provide sleeves for piping passing through floor slab. Caulk around piping and fill entire space between piping and floor slab with approved fire retardant material to maintain required fire rating where necessary.
- .17 Provide fire stop sealant at all pipe penetrations through fire separations.

3.2 Natural Gas Piping

- .1 All gas piping installations shall comply with C.G.A. code C.A.N. 1-B149, gas safety branch bulletins, local codes and N.F.P.A. 96. Provide a C.G.A. approved ball valve where new equipment is to be connected.
- .2 Coordinate new gas meter with local Utilities. Fill out and submit gas meter application form.
- .3 Install gas piping in open or ventilated spaces. Pitch lines and provide drip legs for condensation collection points. Where gas piping is run in a concealed space, provide ventilation grilles as required.
- .4 Provide dog house or ventilated flashing for all gas piping through roof. Refer to details on drawing.
- .5 Provide union, valve and drip leg at final connection to all equipment. Drip leg shall be minimum 50 millimeters (2 inches) above any floor or roof level.
- .6 Refer to Section 23 05 29 for piping supports and roof block supports.
- .7 Gas Regulators
 - .1 Provide regulators as noted on drawings and as required. Size in accordance with loads and equipment. Where installed indoors, vent to the outdoors.
 - .2 Gas pressure regulating valve relief pipe is to be extended upward and remote from the gas vent and the fresh air intake, in compliance with current codes. Provide support and bracing as required.
- .8 Testing and Inspections
 - .1 The Contractor shall perform a soap test and electronic test.
 - .2 Arrange and pay for a gas inspection by the local Gas/T.S.S.A. Inspector.

3.3 Steel Pipe Connection

- .1 Screw joint steel piping up to and including 38 millimeters (1½ inches). Screw or weld 50 millimeters (2 inches) piping. Weld all piping 63 millimeters (2½ inches) and larger, including branch connections. Grooved piping is not acceptable.
- .2 Make screwed joints with standard N.P.T. configuration. Use approved nontoxic joint compound or teflon tape.
- .3 Use full sized tees or main sized saddle type branch connections for directly connecting branch lines to mains in steel piping. Do not project branch pipes inside the main pipe.
- .4 Make reductions in large water pipes with eccentric reducing fittings installed to provide drainage and venting.

3.5 Grades, Routes and Installations

- .1 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space.
- .2 Run exposed piping parallel to walls. Group piping wherever practical at common elevations.
- .3 Install concealed pipes close to the building structure to keep furrings to a minimum.
- .4 On closed systems, equip low points with 19 millimeters (¾ inches) drain valves and hose connection.
- .5 At high points, provide collecting chambers and high capacity float operated automatic air vents.

3.6 Flashing

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

3.7 Sleeves

- .1 Provide and set sleeves required for piping.
- .2 Set sleeves in position in advance of other work. Provide suitable reinforcing around sleeves.
- .3 Extend sleeves through potentially wet floors 50 millimeters above finished floor level. Caulk sleeves full depth and provide floor plate.
- .4 Where piping passes through floor, ceiling or wall, close off space between pipe and sleeve with noncombustible insulation or approved non-

combustible insulation, fire rated as required to match the rating of the penetrated surface. Provide tight fitting metal caps on both sides.

- .5 Install chrome plated escutcheons where piping passes through finished surfaces including millwork.
- .6 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

3.8 Firestop Sealants and Collars

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

3.9 Identification

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

3.10 Testing

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

3.11 Cleaning and Treatment

- .1 Flush, clean and treat piping systems. Refer to Section 23 25 13.

3.12 Glycol

- .1 Install glycol into the system and submit report to Consultant.
- .2 Required mixture is 50 percent water and 50 percent propylene glycol unless otherwise noted.

End of Section

1 General

1.1 Related Sections

- .1 Section 01 74 00 – Cleaning and Waste Management
- .2 Section 23 05 01 – HVAC General Requirements
- .3 Section 23 05 23 – Testing, Adjusting and Balancing
- .4 Section 23 08 02 – Cleaning and Startup of Mechanical Piping Systems
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 23 21 00 – General H.V.A.C. Pipe and Pipe Fittings

1.2 References

- .1 American Society for Testing and Materials (A.S.T.M.)
 - .1 A.S.T.M. D1693, Standard Test for Environmental Stress Cracking of Ethylene Plastics.
 - .2 A.S.T.M. D3035, Standard Specification for Polyethylene (P.E.) Plastic Pipe (D.R.-P.R.) Based on Controlled Outside Diameter.
 - .3 A.S.T.M. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (P.E.) Plastic Pipe and Tubing.
 - .4 A.S.T.M. D3350, Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.
- .2 Canadian Standards Association (C.S.A.)
 - .1 C.S.A. C448 Series-16, Design and Installation of Ground Source Heat Pump Systems for Commercial and Residential Buildings
- .3 International Ground Source Heat Pump Association (I.G.S.H.P.A.)
 - .1 Installation Manuals.
- .4 A.S.H.R.A.E. Handbook 2019 – H.V.A.C. Applications
 - .1 Chapter 35 – Geothermal Energy

1.3 Submittals

- .1 Submittals: in accordance with Section 23 05 01 – H.V.A.C. General Requirements.
- .2 Submit manufacturer's catalog sheets, specifications and installation instructions for each item specified.
- .3 In-situ thermal conductivity testing results (see 3.1).

1.4 Quality Assurance

.1 Geothermal System Installer's Qualifications Data:

- .1 Name of each person who will be performing the geothermal work and their employer's name, business address and telephone.
- .2 Names and addresses of 3 similar projects that each person has worked on.
- .3 Copy of installer's personal experience demonstrating the use of thermal fusion techniques for polyethylene piping.
- .4 The persons performing geothermal work shall be personally trained in polyethylene pipe fusion techniques by I.G.S.H.P.A. or piping manufacturer, personally experienced in geothermal work and shall have been regularly employed by a Company performing geothermal work for a minimum of 2 years.

.2 Geothermal System Supervisor's Qualifications Data:

- .1 Name of person overseeing the geothermal work and their name, business address and telephone number.
- .2 Names and addresses of 3 similar projects that the supervisor has overseen during the past 5 years.
- .3 Copy of installer's personal experience demonstrating the use of thermal fusion techniques for polyethylene piping.
- .4 The supervisor overseeing the geothermal work shall be personally trained in polyethylene pipe fusing techniques by I.G.S.H.P.A. or piping manufacturer, personally experienced in geothermal work, and shall have been regularly employed by a Company performing geothermal work for a minimum of 2 years.

.3 Geothermal System Contractor's Qualifications Data:

- .1 Names and addresses of 3 geothermal projects that the contractor has completed during the past 5 years.
- .2 The contractor shall have completed geothermal work on at least 3 projects with ground loop heat pump piping within the last 5 years.
- .4 I.G.S.H.P.A. Installation Manuals: Maintain one copy on site for review.
- .5 C.S.A. C448 Series-16: Maintain one copy of site for review.

1.5 Regulatory Requirements

- .1 Perform field testing of piping systems in complete accordance with the local utilities and other agencies having jurisdiction and as specified.

1.6 Product Condition

- .1 Protection: During test work, protect adjacent buildings, equipment, vehicles, etcetera, against damage from testing activities.

1.7 Sequencing and Scheduling

- .1 Transmit written notification of proposed date and time of tests to the Owner at least two (2) working days in advance of such tests.
- .2 Perform cleaning and testing work in the presence of Owner and/or Owner's representative.

1.8 Warranty

- .1 Manufacturer's Warranty: Minimum 50 years warranty for polyethylene piping from date of Substantial Completion.
- .2 Special Warranty: 25 years for butt fusion welds in polyethylene piping against leakage from date of Substantial Completion.

1.9 Water, Silt and Soil Containment and Removal

- .1 The Contractor shall submit a detailed proposal outlining their proposed methodology for containing, removing and runoffs created by the well drilling and piping installation.
- .2 Dewater each borehole during drilling utilizing an interceptor and water sump tank arrangement. Remove water from site in a manner in accordance with all authorities having jurisdiction.

2 Products

2.1 High Density Polyethylene (P.E.) Pipe and Fittings

- .1 Pipe and fittings shall be manufactured based on polymers made with ethylene as the sole monomer, which meet the requirements of P.E. Type III for water distribution.
- .2 P.E. Type III pipe shall have a 23.2 kilopascal design stress at 23 degrees Celsius which is listed by the plastics pipe institute (P.P.I.).
- .3 The piping shall be P.E. 3408 (high density polyethylene) with minimum cell classification 345434C per A.S.T.M. D 3350. Resistance to environmental stress cracking is critical to long life expectancy. The piping shall experience zero failures (F.o.) after 5,000 hours under condition "C" (100 percent reagent at 100 degrees Celsius) when tested in accordance with A.S.T.M. D1693. A 50 year limited warranty (in writing) must be issued by the pipe manufacturer. U-type fittings shall be shop fabricated under quality controlled conditions of the same material designation and shall be A.S.T.M. D-3261 certified.

- .4 Pipe shall conform to A.S.T.M. D3035 and A.S.T.M. D3261 for butt fusion fittings. U-bend joints shall be butt heat fused or socket welded.
- .5 Pipe must be designed and fabricated by manufacturer specifically for geothermal heat pump applications. Pipe and tubing shall be marked in accordance with the applicable standard. Pipe markings with "Geothermal" or "Geo" and the standard designation A.N.S.I./C.S.A. C448 shall be used to indicate the intended service.
- .6 The complete assembly of piping within the borehole must be continuous without any joints except at the bottom U-BEND located where only a thermally fused joint or socket welded joint will be acceptable.
- .7 All piping shall be sealed at the factory and contain a compressed air charge. The presence of the air charge must be witnessed at the site prior to hydrostatic testing. Piping without an air charge will not be accepted.

2.2 Anti-Freeze

- .1 Provide a 25 percent by volume solution of polypropylene glycol charge and water for all the entire ground source heat pump closed loop piping.
- .2 The performance characteristics shall be as follows:
 - .1 Viscosity shall be no more than 5.00 centipoise at -1.1 degrees Celsius with blend for -9.4 degrees Celsius freeze protection.
 - .2 Specific heat shall be 1.05 at 21 degrees Celsius with blend for -9.4 degrees Celsius freeze protection.
 - .3 Specific gravity shall be 0.982 at 10 degrees Celsius with blend for -9.4 degrees Celsius freeze protection.
 - .4 Pressure drop and Reynolds Number for a 11.3 l/m flow in NPS ¾ SDR-11 PE pipe of a -1.1 degrees Celsius mixture for a -9.4 degrees Celsius freeze protected blend shall be no more than 0.86 meters of H.D. per 30.0 meters of pipe and no less than Re = 2028 respectively.
- .3 The fluid shall mix easily and readily with water and shall not damage or corrode common tools.
- .4 The fluid shall have a good or excellent material compatibility with iron, copper, red and yellow brass, polyethylene, P.V.C., Viton, Buna "n" neoprene and nylon and shall include an oxygen scavenger blend to reduce any corrosion capability. The fluid shall not have a low surface tension to prevent leakage.
- .5 The fluid shall have a N.F.P.A. 704 Health rating of 0 (least risk).

- .6 The Contractor shall provide a certified test report from a recognized lab stating glycol concentration.
- .7 The product shall be available in plastic 19 liter pails, plastic 208 liter drums, or bulk tanker.

2.3 Borehole Grout

- .1 Provide grout for each of the boreholes as indicated on the drawings. Materials to be utilized by the Contractor shall be a minimum of 20 percent high sodium solids bentonite grout. The bentonite will be a slurry that will be tremie grouted from the bottom of the boring to the surface in accordance with the I.G.S.H.P.A. installation manual. The contractor will work quickly to assure that there are no air voids forming as a result of the bentonite placing.
- .2 Grouting compound shall be certified and listed by National Sanitation Foundation International to A.N.S.I./N.S.F. Standard 60, "Drinking Water Treatment Chemicals - Health Effects".
- .3 The thermal conductivity of the grouting compound must be 1.47 watt per meter by Kelvin (0.85 B.t.u. per hour per foot per Fahrenheit) or greater, equal to Thermal Grout Select as supplied by GeoPro Incorporated or equivalent which is pre-approved by the Owner or Owner's representative.

3 Execution

3.1 In Situ Thermal Conductivity Test

- .1 Prior to the start of ground loop piping and system installation, the thermal properties of the subsurface shall be determined by performing an in-situ thermal conductivity test.
- .2 The number of test vertical borehole heat exchangers shall be as identified by Table 1 of C.S.A. C448.3-16, and as agreed upon with the engineer.
- .3 Vertical borehole heat exchanger shall be drilled to at least the depth indicated on the mechanical site drawings. Testing method shall be as per Thermal Property Testing procedure, as described in 2019 A.S.H.R.A.E. Handbook – H.V.A.C. Applications, Chapter 35 and 4.5 of C.S.A. C448.3-16.
- .4 A minimum of 3 to 5 days shall pass between loop grouting and test startup.
- .5 The test duration shall be 36 hours, minimum. All above ground test piping shall be insulated with a minimum of 0.5 inch closed cell insulation or equivalent. Test rigs shall be enclosed in a sealed cabinet that is insulated with a minimum 1.0 inch fibreglass insulation or equivalent.

- .6 The collected data shall be analyzed using the line source method or other industry-accepted method.

3.2 Geothermal Borehole Piping Installation

- .1 The contractor shall obtain all necessary permits associated with the described work.
- .2 The vertical holes shall be drilled no closer than 9.1 meters apart and shall be held open by a “mud” casing so that the piping can be inserted. The piping shall be tested in accordance with other sections of this specification prior to insertion. Loops must be installed from or by a mechanical device so that the pipe is not rolled out on the ground before installation.
- .3 Install polyethylene piping in accordance with details on drawings.
- .4 The piping shall be capped and protected for future connection.
- .5 Approved borehole seals should be tightened to manufacturer’s specifications.
- .6 The entire piping system shall be pressure tested in accordance with other sections of this specification before any backfilling of trench is permitted.
- .7 The Owner shall be notified two (2) working days prior to the test and shall, at their discretion, witness the test.
- .8 The contractor shall maintain an accurate record of all borehole locations and at the completion of the work, deliver to the owner a set of “as-builts” site plans.

3.3 Grouting Borehole

- .1 Bore holes in vertical heat exchangers shall be tremi-grouted. Grouting of vertical heat exchangers shall be done in accordance with jurisdictional requirements of I.G.S.H.P.A. standards. Grouting shall immediately follow the completion of drilling and installation of each borehole piping. A large capacity grout mixer/separate holding tank are required and a minimum of 25mm diameter polyethylene tubing shall be used as the tremi-grout pipe. The tremi-grout pipe shall be attached to the u-bend heat exchanger before it is lowered into the ground.
- .2 Grouting procedures to be as follows:
 - .1 Monitor the grouting operation to ensure grout is being adequately mixed in correct proportions and that the viscosity is adequate for pumping down the borehole.
 - .2 The grout contractor should have spare grout pipes, hoses, fittings, readily available on site.

- .3 A screw-type pump or a piston pump shall be used to pump grouts down the boreholes.
- .4 A 75 to 100 millimeters inside diameter suction line and a 25 to 50 millimeters discharge line shall be used.
- .5 Bentonite based grout shall be used mixed with water in proportions recommended by manufacturer. Cement based grout will not be used.
- .6 The Contractor shall monitor each borehole and continue adding grout as required for a period of no less than 30 minutes and no longer than 2 hours.

3.4 Piping System Test

- .1 The contractor shall provide all necessary equipment and shall perform all work required in connection with all piping system tests.
- .2 At the water working pressure of the pipe installed, all water piping systems shall be tested. Each section tested shall be slowly filled with water. Care shall be taken to expel all air from pipes. If necessary, the pressure, as measured at the point of lowest elevation, shall be applied for not less than ½ hour. When the test pressure has fallen over 5 percent, the point of leakage shall be found, repaired and tested repeated. This procedure shall be followed until the piping systems have been proved absolutely tight. The use of any chemicals, any “Stop-Leak” compounds, any mastic or any other temporary means shall not be used for repairing leaks during or subsequent to these tests.
- .3 Polyethylene pipe testing:
 - .1 Prior to insertion of the pipe, the contractor shall assembly the “U Bend” and piping, cap both ends, and air pressure test the piping to a pressure of 862 kilopascals. The test must be maintained for 8 hours minimum without the pressure falling more than 20 kilopascals.
 - .2 Loops shall pass the test at the following milestones:
 - .1 Before insertion into hole.
 - .2 After insertion into hole.
 - .3 Contractor is responsible to provide evidence of and certification of pressure testing, and acceptance of all work performed by signature of the Owner.

End of Section

1 General

1.1 Summary

- .1 Section Includes: Hydronic radiant floor heating and cooling distribution system.
 - .1 Provide labour, materials, transportation, equipment and services to install a hydronic radiant floor and cooling system where indicated on the Contract Drawing and specified herein.
- .2 Related Sections:
 - .1 Examine all other portions of the subcontract documents for work or other terms and conditions related to the work of this section.
 - .2 Provide all work hereunder as required for the support and accommodation of related work.

1.2 References

- .1 General: Standards listed by reference, including revisions by issuing authority, form part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title, or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- .2 American Society for Testing and Materials (A.S.T.M.):
 - .1 A.S.T.M. F876 Standard Specification for Cross-Linked Polyethylene (PEX) Tubing.
 - .2 A.S.T.M. F877 Standard Specification for Cross-Linked Polyethylene (PEX).Plastic Hot and Cold Water Distribution Systems.
 - .3 A.S.T.M. F2788 Standard Specification for Metric-Sized PEX Pipe.
 - .4 A.S.T.M. F1960 Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-Linked Polyethylene (PEX) Tubing.
- .3 Underwriters' Laboratories of Canada Inc:
 - .1 C.A.N./U.L.C.-S101 Standard Methods of Fire Endurance Tests of Building Construction and Materials.
 - .2 C.A.N./U.L.C.-S115 Standard Method of Fire Tests of Firestop Systems.

- .3 C.A.N./U.L.C.-S102.2 Standard for Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.
 - .4 Canadian Standards Association (C.S.A.):
 - .1 C.A.N./C.S.A. B137.5 Cross-Linked Polyethylene (PEX) for Pressure Applications.
 - .2 CAN/CSA B214 Installation Code for Hydronic Heating Systems.
 - .5 German Institute of Standards (D.I.N.):
 - 1. D.I.N. 4726 Warm Water Floor Heating Systems and Radiator Connections – Piping Made Out of Plastic Materials.
 - .6 Plastic Pipe Institute (P.P.I.):
 - 1. P.P.I. Technical Report TR-4.
 - .7 Uponor, *Complete Design Assistance Manual* (C.D.A.M.), current edition.
 - .8 Uponor, *Advanced Design Suite* Software.
 - .9 Uponor, *Installation Handbook, Radiant Floor*, current edition.
- 1.3 System Description
- .1 Performance Requirements: Provide hydronic radiant floor heating and cooling system which has been manufactured, fabricated and installed to comply with regulatory agencies and to maintain performance criteria stated by manufacturer without defects, damage or failure. The floor loop design shall be capable of providing the specified heating and cooling loads without altering the flow output of the specified circulators.
- 1.4 Submittals
- .1 General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
 - .2 Product Data: Submit product data for specified products.
 - .1 Submit verification of Standard Grade hydrostatic pressure ratings from Plastic Pipe Institute in accordance with T.R.-4. The following 3 Standard Grade ratings are required: 200 degrees Fahrenheit (93 degrees Celsius) at 80 p.s.i. (551 kilopascals); 180 degrees Fahrenheit (82 degrees Celsius) at 100 p.s.i. (689 kilopascals) and 73.4 degrees Fahrenheit (23 degrees Celsius) at 160 p.s.i. (1102 kilopascals).

- .2 Submit Product Submittal sheets for tubing, manifolds, connection system, loop and/or manifold actuators, thermostats and zone controls.
- .3 Performance Data: Submit manufacturer's design calculations showing compliance with meeting heat and cooling loads based on maximum 110 degrees Fahrenheit average heating supply water and maximum 36 degrees Fahrenheit entering cooling supply water. Additional design calculations shall include:
 - .1 Flowrate in each loop
 - .2 Head loss in each loop
 - .3 Surface temperature(s)
 - .4 Loop design temperature drop(s)
 - .5 Loop spacing(s)
 - .6 Loop length(s)
- .4 Regulatory Listings: Submit applicable U.L., U.L.C., Warnock Hersey, Intertek or Q.A.I. and C.S.A. or N.S.F. listings as proof of compliance with Federal, Provincial and Municipal building codes. Listings shall include the following.
 - .1 Submit listings that indicate that the PEX-a tubing system has been listed to C.A.N./U.L.C.-S101 when the PEX-a tubing is incorporated in and traverses a C.A.N./U.L.C.-S101 floor/ceiling assembly. The listings must be appropriate to assemblies on site.
 - .2 Submit listings that indicate that the PEX-a tubing firestop system has been listed to C.A.N./U.L.C.-S115 when the PEX-a tubing penetrates a fire separation. The listings must be appropriate to assemblies on site.
 - .3 Submit listings that indicate that the PEX-a tubing has been listed to C.A.N./U.L.C.-S102.2 for maximum 25 flame spread and maximum 50 smoke developed.
- .5 Shop Drawings: Submit design print-out of Uponor *Advanced Design Suite* and shop drawings indicating loop layout, manifold locations, initial loop flow balance settings, floor profiles, floor coverings and product components, including anchorage, accessories and finishes.
 - .1 Include installation drawings of tubing layout indicating loop length, loop spacing, tube size and detail notes to aid in installation of system.
 - .2 No fabrication shall be performed until approval is given.

- .6 Quality Assurance Submittals: Submit the following:
 - .1 Copy of certificate indicating that the installer is certified in the installation of the manufacturer's products.
 - .2 Manufacturer's Instructions: Manufacturer's installation instructions.
 - .3 Installer shall provide in writing to the project owner that the PEX-a tubing and components furnished under this specification conforms to the material and mechanical requirements specified herein.
- .7 Closeout Submittals: Submit the following:
 - .1 Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section including methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.
 - .2 Warranty: Warranty documents specified herein.
 - .3 Manufacturer's Field Reports: Manufacturer's field reports specified herein.
 - .4 Final "As-Built" loop layout drawing.
 - .5 Copy of Uponor *Advanced Design Suite* software printout.
 - .6 Record Documents: Project record documents for installed materials in accordance with Division 1 Closeout Submittals (Project Record Documents) Section.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installer Qualifications: Installer shall be experienced in performing work of this section and has specialized in installation of work similar to that required for this project.
 - .2 Installation Qualifications: Installation must be by skilled tradesmen holding a trade qualification license or apprentices under the supervision of a licensed tradesman.
 - .3 Installer Qualifications: Installer must be recognized by the manufacturer as a "Trained Installer".
- .2 Regulatory Requirements: PEX-a tubing and components shall be installed in full compliance with all Federal, Provincial and Municipal codes, standards and requirements. In particular:

- .1 PEX-a tubing shall be listed to a maximum 25 flame spread and maximum of 50 smoke developed per the requirements of C.A.N./U.L.C.-S102.2.
 - .2 PEX-a tubing penetrating a fire separation shall be sealed per C.A.N./U.L.C.-S115.
 - .3 PEX-a tubing contained within a C.A.N./U.L.C.-S101 floor/ceiling assembly shall be listed per C.A.N./U.L.C.-S101.
 - .3 Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, floor coverings, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.
- 1.6 Delivery, Storage and Handling
- .1 General: Comply with Division 1 Product Requirements Sections.
 - .2 Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
 - .3 Delivery: Deliver materials to job site in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - .4 Storage and Protection: Store materials protected from exposure to harmful weather and job site conditions.
 - .1 Store PEX-a tubing in original packaging or under cover to avoid dirt or foreign material from being introduced into the tubing.
 - .2 Do not expose PEX-a tubing to direct sunlight for more than 30 days. If construction delays are encountered, installer is responsible for providing cover to portions of tubing exposed to direct sunlight.
- 1.7 Warranty
- .1 Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
 - .2 PEX Manufacturer's Warranty: Warranty must meet the following conditions:
 - .1 PEX-a tubing shall carry a 25-year non-prorated warranty against failure due to defect in material or workmanship and;
 - .2 Manifolds and fittings shall carry a 5-year non-prorated warranty against failure due to defect in material or workmanship and;

- .3 Controls and electrical components shall carry a 2-year non-prorated warranty against failure due to defect in material or workmanship and;
- .4 Warranty shall provide for repair or replacement of any tube or fittings which are proven to be defective and pay for consequential damages and;
- .5 Warranty shall be transferable to subsequent owners and;
- .6 Effective Warranty: Current manufacturer's warranty at time of installation and;
- .7 Warranty Period: Warranty shall commence on Date of Substantial Completion.

1.8 System Startup and Owner's Instruction

- .1 System Startup: 23 08 02 Cleaning and Start-up of Mechanical Piping Systems
- .2 Owner's Instruction: Instruct Owner's personnel in operation and maintenance of installed units. Provide manufacturer's installation, operation and maintenance instructions for installed units.

2. Products

2.1 Radiant Floor Heating System

- .1 Manufacturer: Uponor Limited
- .2 Proprietary System: Uponor hePEX Radiant Panel Heating System.

2.2 Product Substitutions

- .1 Substitutions: No substitutions permitted.

2.3 Materials

- .1 Tube Materials: Tube shall be cross-linked polyethylene (PEX) manufactured by PEX-a or peroxide method.
 - .1 Tubing Type: Wirsbo hePEX tubing.
 - .2 Oxygen Barrier: Tube shall have an oxygen barrier capable of limiting oxygen migration through the tube wall to no greater than 0.10 g. per meters cubed per day at 104 degree Fahrenheit (40 degrees Celsius) water temperature per the requirements of D.I.N. 4726.
 - .3 PEX-a tubing shall be C.S.A. B137.5 listed for both hydronic and potable water distribution systems.

- .4 PEX-a tubing shall be manufactured in accordance with A.S.T.M. F876 and A.S.T.M. F877. The tube shall be listed to A.S.T.M. by an independent third party agency.
- .5 PEX-a tubing shall be A.S.T.M. F876 tested and approved for excessive temperature and pressure for 725 hours at 210 degrees Fahrenheit (99 degrees Celsius) at 150 p.s.i. (1035 kilopascals).
- .6 PEX-a tubing shall have Standard Grade hydrostatic design and pressure ratings of 200 Fahrenheit (82 degrees Celsius) at 80 p.s.i. (551 kilopascals), 180 degrees Fahrenheit (82 degrees Celsius) at 100 p.s.i. (689 kilopascals), and 73.4 degrees Fahrenheit (23 degrees Celsius) at 160 p.s.i. (1102 kilopascals). Temperature and pressure ratings shall be issued by the Plastic Pipe Institute (P.P.I.), a division of the Society of the Plastic Industry (S.P.I.).
- .7 Minimum bend radius for cold bending of the PEX-a tubing shall not be less than 6 times the outside diameter. Bends with a radius less than stated shall require the use of a bend support as supplied by tube manufacturer.
- .8 PEX-a tubing dimensions shall be:
 - .1 5/8 inch nominal inside diameter in accordance with A.S.T.M. F876.
- .2 Manifold Materials: Stainless Steel manifold shall be fully assembled and mounted on a durable bracket. Manifold shall come fully assembled with air vent and drain on both the supply and return manifold sections, visual loop flow meters and isolation ball valves. Manifold shall be designed to handle maximum 21 g.p.m. for 12-loop manifold. Manifold shall be capable of full flow isolation on each loop.
 - .1 Manifold Type: Stainless-steel Manifold Assembly, 1-1/4 inches with Flow Meter.
 - .2 Manifolds shall be supplied by the PEX-a tubing manufacturer.
 - .3 Manifolds shall have integral manual air vent and drain on both the supply and return manifold.
 - .4 Manifolds shall be manufactured from stainless steel.
 - .5 Manifolds shall be supplied with manufacturers mounting brackets.
 - .6 Manifolds shall be pre-assembled with visual loop flow indicators.
 - .7 Manifolds shall be pre-assembled with isolation ball valves.
 - .8 Manifolds shall 1 inch internal barrel diameter.

- .3 Manifold Isolation Ball Valves: Manifolds shall be isolated at the inlet and outlet of the manifold with full flow ball valves. The supply ball valve shall have an internal strainer.
 - .1 Isolation Ball Valve Type: Uponor supply and return ball valves.
 - .2 Isolation ball valves shall be supplied by the PEX-a tubing manufacturer.
- .4 Fitting Materials: Fittings shall be manufactured of polysulfone or dezincification resistant brass. Fittings shall be nose cone insert type compression fitting, nose cone insert type swivel fitting or PEX-a cold expansion type fitting.
 - .1 Fittings shall be supplied by the PEX-a tubing manufacturer.
 - .2 Compression fitting shall be an assembly consisting of nose cone insert, compression ring and compression nut.
 - .3 Swivel fitting shall be an assembly consisting of nose cone insert, swivel nut and PEX-a cold expansion ring.
 - .4 PEX-a cold expansion type fitting shall be an assembly consisting of insert and PEX-a cold expansion ring.
- .5 Supply and Return Piping to Manifolds: Piping run in heated spaces shall be cross-linked tubing with oxygen diffusion barrier capable of limiting oxygen migration through the tube wall to no greater than 0.10 g. per meters cubed per day at 104 degrees Fahrenheit (40 degrees Celsius) water temperature per the requirements of D.I.N. 4726. Supply and return piping run underground shall be cross-linked tube encased in a pre-insulated polyethylene corrugated jacket.
 - .1 Supply and Return Piping Type: Wirsbo HePEX tubing
 - .2 Pre-insulated Supply and Return Piping Type: Uponor Ecoflex

2.4 Accessories

- .1 Water Temperature and HVAC Controls: Refer to the controls section of the tender document.
- .2 Thermostats: Thermostats shall be of type designed specifically for Radiant Floor Heating and shall have slab sensing capability. Thermostats shall be supplied by PEX-a tubing manufacturer.
 - .1 Thermostat Type: Uponor 512 programmable two-stage controller.
- .3 Loop Valve Actuators: Individual loop actuators shall be thermally actuated for quiet operation. Valve actuators shall be supplied by PEX-a tubing manufacturer.

- .4 Zone Control Panels: Zone control panels with LED lights indicating zone operational status shall be provided for each manifold location. Zone control panels shall be supplied by PEX-a tubing manufacturer.
 - .5 Manifold Cabinets: All manifolds shall be mounted in a recessed metal cabinet. The cabinet shall be lockable and be able to be painted. The cabinets shall be supplied by the PEX-a tubing manufacturer.
- 2.5 Related Materials
- .1 Related Materials: Refer to other sections listed in Related Sections paragraph herein for related materials.
- 3 Execution
- 3.1 Manufacturer's Instructions
- .1 Compliance: Comply with manufacturer's product data, including product technical bulletins, installation instructions and product packaging instructions for installation.
- 3.2 Examination
- .1 Site Verification of Conditions: Verify substrate conditions which have been previously installed under other sections, are acceptable for installation in accordance with manufacturer's instructions.
- 3.3 Installation
- .1 Radiant Heating and Cooling Installation:
 - .1 Install hydronic radiant heat and cooling tubing loops in accordance with tubing manufacturer's recommendations and as indicated on Contract Drawings. Installation shall follow shop drawings for tube layout, tube spacing, manifold configuration, and manifold location. Comply with notes on shop drawings.
 - .2 Manifolds supply and return piping shall be isolated with ball valves.
 - .3 Fittings and manifolds shall be accessible for maintenance. The only exceptions are for repair splice with manufacturer's approved fittings and procedure for concealed connections.
 - .4 Install tubing loops without splices. It is acceptable to install a repair splice within the embedded loop should on-site damage occur and an emergency repair be authorized. Refer to PEX-a tubing manufacturer's installation handbook for instructions on the proper installation of the repair splice.
 - .5 Ensure that no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tube manufacturer.

- .6 Manufacturer's bend supports shall be used where tubing enters and exits the slab.
 - .7 Methods of tubing attachment shall be to manufacturer's installation handbook.
 - .8 Pressurize tubing system with air or water in accordance with applicable codes or, in the absence of applicable codes, to a pressure of 60 p.s.i. (413 kilopascals) for 24 hours prior to encasement of tubing system. Tubing shall remain pressurized during encasement and for a period of 24 hours thereafter to ensure system integrity.
 - .9 Comply with safety precautions when pressure testing, including use of compressed air, where applicable. Water shall not be used to pressurize the system if ambient air temperature has the possibility of dropping below 32 degrees Fahrenheit (0 degrees Celsius).
 - .10 Ensure system is freeze proof should ambient air temperature be anticipated to drop below 32 degrees Fahrenheit (0 degrees Celsius) and the system is not under full operation.
 - .11 Initial Balancing: Adjust flow to all loops as indicated on shop drawings. Flow adjustment settings are to be generated by the Uponor *Advanced Design Suite* software.
 - .12 System shall not be operated during panel concrete curing period unless permission has been granted and specific instructions on panel pre-heating has been provided.
 - .2 Related Products Installation: Refer to other sections listed in Related Sections paragraph herein for related products installation.
- 3.4 Field Quality Requirements
- .1 Site Tests (Installation and Post-Installation Testing): Provide pressure test, water balance and controls verification.
 - .2 Manufacturer's Field Services: Provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions.
 - .1 Site Visits: Provide site visits as required to complete scope of work.
- 3.5 Adjusting

- .1 Adjusting: Balance all loops to equal temperature drops after radiant floor heating system has been in operation and building temperature has stabilized to normal operating conditions.

3.6 Cleaning

- .1 Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project site and legally dispose of debris.

3.7 Protection

- .1 Protection: Protect installed product and finish surfaces from damage during construction.

End of Section

- 1 General
 - 1.1 Standards
 - .1 Construct pressure tanks to A.S.M.E. Code for Unfired Pressure Vessels.
 - .2 Comply with Provincial Government Regulations.
 - 1.2 Submittals
 - .1 Submit with shop drawings for tanks, specifications of tank lining and installation instructions.
 - 1.3 Inspections
 - .1 Obtain inspection certificates for pressure vessels from Provincial Authorities as required.
 - 1.4 Acceptable Manufacturers:
 - .1 Axiom
 - .2 Neptune
 - .3 Wessel
- 2 Components
 - 2.2 Glycol Tank
 - .1 The Contractor shall supply and install, as indicated on the plans and in the specifications, a prefabricated, automatic and autonomous make-up package for the glycol system.
 - .2 The package shall be designed to occupy a minimum amount of floor space to operate on a standard 110 volt, 60 hertz electrical circuit, and to maintain a fill pressure in the glycol system as per schedule.
 - .3 It shall feature a cut-off and alarm arrangement which will stop the pump in case of excessive pressure, or a low solution level, and activate an audible (which can be silenced) and a visual alarm. A 110 volt signal shall also be available for a remote alarm.
 - .4 A translucent polyethylene solution container, complete with lid, shall be mounted on the pumping assembly and shall include a strainer and a shut off valve. A glycol solution recovery line shall be piped in from the system relief valve outlet to the solution container, through its lid in such a way that the lid can be removed for filling and mixing.
 - .5 The pumping assembly shall be mounted in a sturdy steel frame with legs to keep it off the floor. It shall include a pump (1/3 horsepower motor), a magnetic starter, a pressure tank with a pressure control, a priming valve, a pressure reducing valve, a shut-off valve and a pressure gauge. It shall be connected to the system with a ½ inch N.P.T. connection.

.6 Provide propylene glycol to provide glycol mix in tank.

3 Execution

3.1 General

.1 Install tanks on 4 inch thick concrete housekeeping pad. Coordinate with general contractor.

3.3 Glycol Tank

.1 After receiving permission from the Consultant to open the valves, follow manufacturers recommendations for tank fill. Mix water and glycol to provide a 80 percent water/20 percent propylene glycol mix. Submit report on final ratio and pressure.

.2 Set pressure relief valve below 90 p.s.i.

.3 Set pressure reducing valve on make-up water line to suit system operating conditions.

End of Section

- 1 General
 - 1.1 Standards
 - .1 Construct pressure tanks to A.S.M.E. Code for Unfired Pressure Vessels.
 - .2 Comply with Provincial Government Regulations.
 - 1.2 Submittals
 - .1 Submit with shop drawings for tanks and installation instructions.
 - 1.3 Inspections
 - .1 Obtain inspection certificates for pressure vessels from Provincial Authorities as required.
 - 1.4 Acceptable Manufacturers:
 - .1 Armstrong
 - .2 Bell and Gossett
- 2 Products
 - 2.1 Hydronic Expansion Tank
 - .1 A.S.M.E. rated, pre-charged plain steel expansion tank, painted.
 - .2 Designed and constructed per A.S.M.E. Section VIII, Division 1. The tank shall be constructed and stamped in accordance with section VIII of the A.S.M.E. Boiler and Pressure Vessel Code.
 - .3 The tank shall have N.P.T. system connection, glass tappings and drain.
 - .4 Tank shall be furnished with a base ring for vertical storage or optional saddles for horizontal mount.
 - .5 The tank shall have site glass.
 - .6 Shell: Carbon Steel.
 - .7 Heads: Carbon Steel.
 - .8 Charge Pressure: 12 p.s.i..
 - .9 Maximum working pressure: 150 p.s.i. (1034 kilopascals).
 - .10 Maximum water temperature: 450 degrees Fahrenheit (232).

PART 3 - EXECUTION

- 3.1 Hydronic Expansion Tank
 - .1 Mount tanks on 10 millimeter (4 inch) thick concrete housekeeping pads as per Section 23 05 29.

- .2 Confirm that the air charge is preset and correct prior to opening water valves.
- .3 Follow manufacturer's recommendations for tank charging and commissioning.
- .4 Set pressure relief valve below 90 p.s.i.. Pipe to drain.
- .5 Set pressure reducing valve on make up water line to 15 p.s.i. unless otherwise required to suit operation conditions.

End of Section

1 General

1.1 Submittals

- .1 Refer to Section 23 05 01 – General Mechanical Requirements.
- .2 Submit with shop drawings certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include N.P.S.H. when applicable.
- .3 Submittals without pump head versus flow curves will be discarded. Tabulated data is not acceptable.

1.2 Quality Assurance

- .1 Pumps shall be aligned by qualified millwright and alignment certified.
- .2 Ensure pumps operate at specified system fluid temperatures. Operate within 25 percent of midpoint of published maximum efficiency curve.
- .3 Polyphase, squirrel cage, single speed N.E.M.A./E.E.M.A.C. Design A or B induction motors, between 1 horsepower and 200 horsepower, whether in packaged equipment or not, shall comply with the current requirements of the Ontario Energy Efficiency Standards Regulation, and specifically, C.S.A. C390-93 Energy Efficiency Test Methods for Three Phase Induction Motors.

1.3 Acceptable Manufacturers

- .1 Manufacturers of pumps whose products are approved in principle, but subject to requirements of drawings and specifications are:
 - .1 I.T.T. – Bell and Gossett
 - .2 Armstrong

1.4 Alternatives

- .1 Equivalent pump selections shall not change type, configuration or motor power, increase noise level, increase speed by more than 10 percent or increase inlet velocity.
- .2 Alternative pump selections shall include plotted pump head vs. flow curves for both the proposed alternative pump and the specified pump on the same graph. The alternative pump curve shall exceed the specified pump performance, and shall not cross the specified pump curve at any point.

2 Products

2.1 General

- .1 Statically and dynamically balance rotating parts.

- .2 Construction shall permit complete servicing without breaking piping or motor connections.
- .3 Pumps shall operate at 1,750 r.p.m. unless specified otherwise.
- .4 Pump connections shall be flanged for sizes 63 millimeters (2½ inches) and over. Grooved or union connections are approved for pump connections 50 millimeters (2 inches) and under.
- .5 Units shall be completely factory wired, tested and name-plated before shipment. Pump manufacturer shall be I.S.O.-9001 certified.
- .6 Pumps shall meet types, sizes, capacities, and characteristics as scheduled on the Equipment Schedule drawings. Refer to schedules for unit performance.
- .7 Units shall be specifically designed for chilled water and hot water heating systems as indicated on the drawings. Complete unit shall be E.T.L.-Canada listed.
- .8 Pumps shall conform to A.N.S.I./H.I. 9.6.3.1 standard for Preferred Operating Region (P.O.R.) unless otherwise approved by the engineer. The pump NPSH shall conform to the A.N.S.I./H.I. 9.6.1-1997 standards for *Centrifugal and Vertical Pumps for N.P.S.H. Margin*.
- .9 Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Pump and motors shall be factory aligned, and shall be realigned (laser alignment) after installation by the manufacturer's representative. Motors shall be non-overloading at any point on the pump curve and shall meet N.E.M.A. specifications and conform to the standards outlined in E.I.S.A.
- .10 The pump(s) vibration limits shall conform to Hydraulic Institute A.N.S.I./H.I. 1.1-1.5-1994, section 1.4.6.1.1 for recommended acceptable unfiltered field vibration limits (as measured per H.I. 1.4.6.5.2, Figure 1.108) for pumps with rolling contact bearings.
- .11 Pumps shall be designed for operation at 225 degrees Fahrenheit and 175 P.S.I.G. working pressure unless scheduled otherwise on the drawings.
- .12 Base mounted pumps shall have the seismic capability to withstand a horizontal load of 0.5 g., excluding piping and/or fasteners used to anchor the pump to mounting pads or to the floor, without adversely affecting pump operation.

2.2 Vertical In-Line Hydronic Water Circulating Pumps

- .1 Type: Centrifugal, single stage, close coupled in-line, pull-out design, suitable for horizontal or vertical operation.
- .2 Casing: Cast iron, rated for greater of 860 kilopascals (125 p.s.i.) or 1.5 times actual discharge working pressure, suction and discharge gauge

port, air vent, wear rings, seal flush connection, drain plug, flanged suction and discharge.

- .3 Impeller: cast steel, fully enclosed, keyed to shaft and secured with locknut.
- .4 Shaft: stainless steel or carbon steel with bronze or stainless steel sleeve through seal chamber.
- .5 Seals: Carbon rotating against a stationary ceramic seat.
- .6 Motors shall have a lifting tab or tapped hole on the motor casing for insertion of 3/8 inch eyelet for lifting of motor.
- .7 Suction guide and strainer.

2.3 Base Mounted Hydronic Water Circulating Pumps

- .1 The pumps shall be long coupled, base mounted, single stage, end suction or double suction, vertical split case design, in cast iron bronze fitted construction.
- .2 Vertical split case pumps shall have a center drop-out type coupling between the pump and the motor. Coupler shall allow for removal of pump's rotating element without disturbing pump volute or movement of the pump's motor.
- .3 Pumps shall be capable of being serviced without disturbing piping connections, electrical motor connections or pump to motor alignment.
- .4 The bearing housing shall supply support for heavy-duty single row permanently lubricated ball bearings, with provision for purging or flushing if desired. The bearings shall be capable of absorbing both radial and thrust loads while maintaining the rotating element in proper axial alignment.
- .5 The impeller shaft shall be of solid 416 stainless steel material.
- .6 Pump shall be equipped with an internally flushed mechanical seal assembly installed in an enlarged tapered seal chamber. Seal assembly shall have a brass housing, seat gasket, stainless steel spring, and be of a carbon ceramic design with the carbon face rotating against a stationary ceramic face.
- .7 Pump volute shall be of a cast iron design with an integrally cast pump discharge and suction. Flanges shall be extra heavy-duty design and will be of 250# thickness while capable of being drilled for 125# A.N.S.I. flat face use. Volute shall have integrally cast support feet, gauge ports at nozzles, and vent and drain ports.

- .8 A coupling, capable of absorbing torsional vibration and of operating in variable speed applications, shall be employed between the pump and motor.
 - .9 An A.N.S.I. B15.1 and O.S.H.A. 1910.219 compliant coupling guard shall shield the coupler during operation. Coupler guard shall contain viewing windows for inspection.
 - .10 Motor base plate shall be welded structural steel fully enclosed at sides and ends, with securely welded cross members. The minimum base plate stiffness shall conform to A.N.S.I./H.I. 1.3-2000, section 1.3.5.3 for *Horizontal Base Plate Design* standards.
 - .11 Pump rotation shall be right-hand or left-hand as viewed from the pump's motor end and in respect to the discharge flange.
 - .12 Provide Suction Diffusers as follows:
 - .1 Single suction diffusers shall consist of an angle type body with internal straightening vanes that run the full length of the diffuser and a combination diffuser/strainer/orifice cylinder with 3/16 inch diameter openings for pump protection.
 - .2 Double suction diffusers shall consist of a ductile iron double suction angle type body with internal exiting vanes, integrally cast flanges or grooved pump connections, and a 1-1/2 inches blowdown connection. Internal design shall equally split half of the system flow to each side of a double suction type pump's impeller.
 - .3 Diffusers for closed system operation shall be equipped with a readily replaceable start-up strainer.
- 2.4 Inline Circulator Pump with E.C.M. control
- .1 The pumps shall be a wet rotor inline pump, in cast iron or lead free stainless steel body construction specifically designed for quiet operation. Suitable standard operations at 230 degrees Fahrenheit and 175 P.S.I.G. working pressure. The pump internals shall be capable of being serviced without disturbing piping connections.
 - .2 The pump internals shall be capable of being serviced without disturbing piping connections.
 - .3 Pump shall be equipped with a water-tight seal to prevent leakage.
 - .4 Pump volute shall be of a cast iron design for heating systems or lead free stainless steel for domestic water systems. The connection style on the cast iron and stainless steel pumps shall be flanged.
 - .5 Flange to Flange dimension shall be standard Bell & Gossett booster sizes such as 6-3/8 inches, 8-1/2 inches, 11-1/2 inches, and 12 inches. Flange dimensions shall be H.V.A.C. industry standard 2 or 4 bolts sizes.

- .6 Motor shall be a synchronous, permanent-magnet (P.M.) motor and tested with the pump as one unit. Conventional induction motors will not be acceptable.
- .7 Each motor shall have an Integrated Variable Frequency Drive tested as one unit by the manufacturer.
- .8 Integrated motor protection shall be verified by U.L. to protect the pump against over/under voltage, over temperature of motor and/or electronics, over current, locked rotor and dry run (no load condition).
- .9 Pump shall have MODBUS or BACnet connections built into the V.F.D. as standard options.
- .10 Analog inputs, such as 0-10 volt and 4-20 m.A., are standard inputs built into the V.F.D.
- .11 Pumps shall be U.L. 778 listed and bear the U.L. Listed Mark for U.S.A. and Canada with on-board thermal overload protection.
- .12 Pumps shall be U.L. 778 listed and bear the U.L. Listing Mark for U.S.A. and Canada with on-board thermal overload protection.
- .13 Each pump shall be factory performance tested before shipment.

2.5 Suction Diffuser

- .1 Provide suction diffuser for each pump.
- .2 Body: cast iron with flanged connections.
- .3 Strainer: with built-in disposable 1.19 millimeters (3/64 inch) mesh, low pressure drop screen and N.P.S. 25 millimeters (1 inch) blowdown connection.
- .4 Permanent magnet particle trap.
- .5 Full length straightening vanes.
- .6 Pressure gauge tapings.
- .7 Adjustable support leg.
- .8 Manufacturer shall match pump manufacturer.

2.6 Triple Duty Valves

- .1 Not acceptable.

3 Execution

3.1 General

- .1 Contractor shall install pumps and suction guides in accordance with manufacturer's guidelines.

- .2 Triple duty valves are not acceptable. Install circuit balancing valve and check valve as per detail on drawings.
- .3 All electrical wiring and accessories, including power wiring from motor control centers and/or motor starter to driven motor, shall be installed in accordance with the requirements specified by Division 16 and the local electrical authority.
- .4 Furnish the services of a factory trained representative to review the installation, and to provide equipment startup. Start-up shall include laser alignment of pump and motor assembly.
- .5 Remove temporary strainers after flushing is complete and leave in mechanical room for inspection/confirmation by the Consultant.
- .6 In-line heating pumps: install on stands with neoprene/steel/neoprene vibration isolator pads.
- .7 Base mounted heating pumps: supply and install concrete inertia bases complete with flexible pipe connectors on both the suction and discharge side of the pump. Inertia bases shall be 10 inches thick complete with 2 inch deflection springs. The inertia pad shall have reinforcement bars running in two directions on 9 inch centers, as well as locating anchors for the pump base. Level and grout the base according to manufacturer's instructions.
- .8 For inline circulating pumps, support piping adjacent to pump such that no weight is carried on pump casings. Do not provide supports directly on pump casings. Provide supports under elbows on pump suction and discharge line sizes 75 millimeters (3 inches) and over.

End of Section

1 General

1.1 Reference Standards

- .1 Ontario Building Code
- .2 S.M.A.C.N.A.
- .3 N.F.P.A. 90A – Air Conditioning and Ventilation Systems
- .4 A.S.T.M. A653
- .5 U.L.C.
- .6 Local Codes and Requirements

2 PRODUCTS

2.1 General

- .1 Provide ductwork as recommended and specified in the latest revision of the Sheet Metal and Air Conditioning Contractors National Association incorporated (S.M.A.C.N.A.).

2.2 Ductwork

- .1 Galvanized steel with G90 designation zinc coating lock forming quality to A.S.T.M. A525M.
- .2 Rectangular or Square:
 - .1 Conform to S.M.A.C.N.A. standards.
- .3 Round:
 - .1 Factory fabricated, spiral wound, with matching fittings and specials. Longitudinal seam type is not acceptable.
 - .2 Transverse joints up to 900 millimeters (36 inches): slip type with tape and sealants.
 - .3 Transverse joints over 900 millimeters (36 inches): Ductmate or Exanno Nexus Duct System.
- .4 All exposed ductwork in finished areas shall be spiral with galvanealed finish unless otherwise indicated.

2.3 Duct Construction

- .1 All ductwork shall be constructed to S.M.A.C.N.A. 500 pascals (2 inches w.g.) duct construction class.
- .2 Tie rods shall not be used in lieu of external duct reinforcement except where specifically mandated by S.M.A.C.N.A. duct construction standards.

- .3 Duct tapers to be at 14 degrees maximum (1:4 ratio) for all systems with air velocities less than 1500 f.p.m. and 8 degrees (1:7 ratio) for velocities 1500 f.p.m. and greater.
- .4 The contractor shall provide a schedule of proposed duct construction, meeting S.M.A.C.N.A. standards, to be used on the project. Schedule shall include panel width, gauge, transverse connector, reinforcement, longitudinal seam, sealing class and sealing compound. Submit schedule prior to performing any duct fabrication/installation.

2.4 Fittings

- .1 Fabrication: to S.M.A.C.N.A..
- .2 Radiused elbows:
 - .1 Rectangular: standard radius and or short radius with single thickness turning vanes Centreline radius: 1.5 times width of duct.
 - .2 Round: in exposed areas one-piece smooth radius, 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400 millimeters (16 inches): with single thickness turning vanes.
 - .2 Over 400 millimeters (16 inches): with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with 45 degree entry on branch.
 - .2 Round main and branch: enter main duct at 45 degree with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Diffuser connection to main:
 - .1 High efficiency takeoffs complete with rectangular duct opening and 45 degree slope body. Takeoffs shall be furnished complete with balancing damper and locking quadrant.
 - .2 Contractor shall notify Consultant if height of takeoff is required to be reduced to suit ceiling clearances and obtain approval from the same prior to installing or fabricating.
- .6 Transitions:

- .1 Diverging: 20 degree maximum included angle.
 - .2 Converging: 30 degree maximum included angle.
 - .7 Offsets:
 - .1 Full short radiused elbows.
 - .8 Obstruction deflectors: maintain full cross-sectional area.
- 2.5 Firestopping
- .1 40 millimeters by 40 millimeters by 3 millimeters (1-1/2 inches by 1-1/2 inches by 1/8 inch) retaining angles all around duct, on both sides of fire separation.
 - .2 Firestopping material and installation must not distort duct.
 - .3 All ductwork passing through partition walls shall be firestopped.
- 2.6 Fasteners
- .1 Fasteners shall be sheet metal screws, rivets, and bolts.
- 2.7 Flexible Ductwork – Non-Metallic, Insulated
- .1 Factory fabricated to C.A.N./U.L.C. S110 and classified Class 1.
 - .2 Flame spread rating not to exceed 25. Smoke spread rating not to exceed 50.
 - .3 Semi-rigid and lightweight air duct, manufactured using a dead soft aluminum strip which is spirally wound and mechanically joined together to form an air tight and leak-proof three ply mechanical seam. Self-supporting and corrosive resistant that provides excellent strength and rigidity.
 - .4 Provide insulated for all supply air applications unless otherwise noted.
 - .5 Performance - Uninsulated:
 - .1 Material: Aluminum
 - .2 Maximum rated velocity: 5500 f.p.m.
 - .3 Maximum positive pressure: 2.5 kilopascals (10 inch w.c.)
 - .4 Maximum negative pressure: 3.0 kilopascals (12 inch w.c.)
 - .5 Temperature Range: minus 51 degrees Celsius to 315 degrees Celsius (minus 60 degrees Fahrenheit to 600 degrees Fahrenheit)
 - .6 Bend Radius : 1.5 times diameter
 - .7 Available sizes : 50 millimeters to 610 millimeters (2 inches to 24

inches)

.6 Performance – Insulated:

- .1 Core material: Aluminum
- .2 Thermal Resistance: Available in R4.2, R6, R8
- .3 Maximum rated velocity: 4000 f.p.m.
- .4 Maximum positive pressure: 3.0 kilopascals (12 inches w.c.)
- .5 Maximum negative pressure: 0.25 kilopascals (1 inch w.c.)
- .6 Temperature Range : minus 40 degrees Celsius to 121 degrees Celsius (minus 40 degrees Fahrenheit to 250 degrees Fahrenheit)
- .7 Bend Radius : 1.5 times diameter
- .8 Available sizes : 100 millimeters to 500 millimeters (4 inches to 20 inches)

.7 Acceptable Manufacturers:

- .1 Uninsulated: Flexmaster Triple Lock T/L Aluminum Flexible Ducting
- .2 Insulated: Flexmaster Triple Lock T/L Aluminum Thermal Flexible Ducting

2.8 Hangers and Supports

- .1 Refer to Section 23 05 29.

2.9 Duct Sealer

- .1 Duct Sealer to be U.L.C. classified for surface burning characteristics and be water based.
- .2 Duct Sealer shall be Duro-Dyne D.W.N., grey, water-based for medium and high pressure duct systems, non-flammable (wet state), fire retardant (dry state).
- .3 Duct Sealer shall be clear silicone type on all exposed ductwork or duct sealer shall be applied to inside of fittings to ensure clean look.

2.10 Turning Vanes

- .1 Turning Vanes shall be of steel construction with prime coat finish and complete with supports and fastenings.
- .2 Turning vanes shall have correct airfoil pattern as mandated by S.M.A.C.N.A..

2.11 Instrument Test Ports

-
- .1 Instrument port covers shall be Duro-Dyne I.P.-1 for bare ducts and I.P.-2 for insulated ducts.
- 3 Execution
- 3.1 Rigid Ductwork
- .1 Coordinate with other trades prior to installing ductwork.
 - .2 All ductwork and fittings shall be installed in accordance with S.M.A.C.N.A. and A.S.H.R.A.E. standards.
 - .3 Duct tapers to be at 14 degrees maximum (1:4 ratio) for all systems with air velocities less than 1500 f.p.m. and 8 degrees (1:7 ratio) for velocities 1500 f.p.m. and greater.
 - .4 Ductwork shall be properly constructed, braced, connected and jointed. Suspend with hangers to S.M.A.C.N.A. Standards. Refer to Section 23 05 29.
 - .5 Do not suspend hangers including wires and rods from the steel roof deck nor from other mechanical or electrical components. Support hangers from structural bearings such as beam, top chords of steel joists or structural concrete slabs. Where structural bearings do not exist, provide angle or channel iron form nearest structural bearings to support hangers.
 - .6 Use of "S and drive" or equivalent slip joint method, or Ductmate flange joint method is permissible. Fabricate and install in accordance with S.M.A.C.N.A. reinforcement standards. Leave smooth finish on edges and interior of duct runs. Install internal ends of slip joints in direction of flow.
 - .7 Ducts and joints shall be tight and rigid so as not to leak, rattle, or vibrate.
 - .8 Install ductwork to allow adequate space for normal operation and maintenance of equipment nearby.
 - .9 Where possible, radiused duct elbows with radiused splitter vanes are preferable over square elbows with turning vanes. Where square duct elbows are necessary, turning vanes to be double thickness airfoil type installed in every slot on the vane rail.
 - .10 Direct size duct spin-ons are not acceptable. Conical spin-on or square-to-round fittings shall be provided. Where take-off is same size as main, use a 45 degree lead-in fitting.
 - .11 Where ducts pass through walls, seal around ducts with noncombustible material.
 - .12 All openings through wall must be sleeved and lined as specified. Openings shall be 50 millimeters (2 inches) larger all around than duct or

pipng and filled with fireproof Rockwool type insulation complete with fire retardant sealant both sides.

- .13 All open ductwork, not being worked on, must be completely covered during construction phase until all sanding, plastering, painting, and finishing is complete.
- .14 Inspect and test ductwork prior to any required painting or insulation for air leakage at joints and connections under normal operating conditions. Air leakage tests shall be performed as specified herein.
- .15 Paint ductwork visible through registers, grilles and diffusers flat black.
- .16 Under no conditions are pipes, rods or wires allowed to penetrate ducts.
- .17 Kitchen exhaust duct shall be welded, sloped and with access doors in conformance with N.F.P.A. 96.

3.2 Flexible Ductwork

- .1 Install in accordance with S.M.A.C.N.A..
- .2 Maximum length shall be 1.8 meters (6 feet). Minimum 12 inches (300 millimeters) straight vertical duct run to be provided at all diffusers.
- .3 Provide support at centre of flexible duct.

3.3 Duct Sealing

- .1 Seal all ductwork with duct sealer as specified herein. Ducts constructed to S.M.A.C.N.A. 500 pascals (2 inches) duct construction class and under shall be sealed to S.M.A.C.N.A. Standard Section 1.6 and 1.7, Class C. Ducts constructed to S.M.A.C.N.A. 750 pascals (3 inches) duct construction class shall be sealed to S.M.A.C.N.A. Standard Section 1.6 and 1.7, Class B. Duct sealer shall be applied behind fittings for all exposed ductwork in finished areas.
- .2 The sealer shall be stored at room temperature for at least 24 hours prior to use. Surfaces shall be clean, dry and free from oil, grease, and any other foreign material.
- .3 Clean fittings to a depth of four inches with a solvent, exercising safe practices as recommended by the manufacturer.
- .4 Stir sealer thoroughly before application.
- .5 Use a brush, cartridge guns or spatula to apply the sealer to male section of spiral duct or to both fittings of rectangular duct. Join joints while sealer is wet (within approximately 15 minutes) and secure with sheet metal screws applied as close as possible (1/2 inches or less). Apply sealer to outside of assembly with a 2 inches wide band of sealer, thoroughly

covering joint head and sheet metal screws. Allow sealer to set (approximately 72 hours) before pressure testing. Do not thin.

- .6 The Consultant shall inspect the duct sealing prior to any insulation being installed.

3.4 Duct Leakage Tests

- .1 Test all air systems for leakage in accordance with S.M.A.C.N.A. procedures including supply air, return air, outside air and exhaust air. Calibrated orifices shall be used to measure all leakage airflow rates. All ductwork shall be pressure tested at minimum 500 pascals (2 inches W.G.). For any system, total leakage at the test pressure shall not exceed 5 percent of respective fan design air flow rate. For constant volume (C.V.) systems, test all supply air ductwork from air handler to air terminals including fire dampers but excluding air terminals. For return and exhaust air ducts, blank grilles or open ducts and test duct from fan inlet to most remote inlet including fire dampers, access doors and silencers. Repair all leaks and repeat test. Pressurize with small blower. Test system as a whole, or in parts, provided that all ductwork is accessible for inspection at the time of test.
- .2 Tests shall be performed before ducts are insulated or enclosed. Submit notice of all tests in ample time to allow the Consultant or their representative to be present when the tests are conducted. All tests shall be witnessed by the Consultant and the Owner's third party commissioning agent or they shall be repeated.
- .3 Any components of the systems which might be damaged during the tests shall be removed before the tests and reinstalled after the tests.
- .4 Provide all test holes (including prefabricated insulated capped test hole fittings), dampers, access facilities, etc. as required for air balancing and make any changes required for the final balancing results. Cooperate with the Balancing Contractor to ensure satisfactory completion of his work. Provide test holes prior to application of thermal insulation.
- .5 Submit report of air tests to Consultant and include in maintenance manuals.

3.5 Instrument Test Ports

- .1 Provide Durodyne I.P.-1 test ports in all uninsulated duct branches within mechanical rooms. Standard plugs may be used in uninsulated ducts outside of mechanical rooms.
- .2 Provide Durodyne I.P.-2 test ports in all insulated duct branches throughout the building.

- .3 Ports shall be supplied and installed by the mechanical contractor prior to installation of external insulation.
- .4 With the assistance of the balancing contractor, the contractor will mark the spacing for the instrument ports on the ductwork after installation of the ductwork and notify the commissioning team of the number of ports.

3.6 Painting

- .1 All exposed ductwork in finished areas shall be painted by the General Contractor.

3.7 Cleaning (prior to start-up)

- .1 Keep ductwork and duct liners clear from dust and debris during construction.
- .2 Prior to starting H.V.A.C. equipment, inspect and clean all equipment, and ductwork on the inside and outside to ensure that they are completely free from dust and debris.
- .3 Install clean filters in all units.

End of Section

1 General

1.1 Reference Standards

- .1 Ontario Building Code
- .2 A.S.H.R.A.E.
- .3 S.M.A.C.N.A.
- .4 N.F.P.A. 90A – Air Conditioning and Ventilation Systems
- .5 U.L.C.
- .6 C.S.A.
- .7 Local Codes and Requirements

1.2 Submittals

- .1 Submit shop drawings showing location, ratings, sizes of all fire dampers, where applicable.
- .2 One copy of all stamped reviewed shop drawings plus operation and maintenance data shall be included in the maintenance manual.

2 Products

2.1 General

- .1 All required accessories shall conform to A.S.H.R.A.E. and S.M.A.C.N.A. standards and recommendations.

2.2 Fire Dampers

- .1 Provide fire dampers in ducts penetrating fire rated walls, floors, or ceiling as indicated on the drawings.
- .2 Fire dampers shall be U.L. S.T.D. 555 to 1-1/2 hour fire ratings or to suit the penetration crossed.
- .3 Fire dampers shall be equipped for vertical or horizontal suitable for application.
- .4 Frame: 4-7/8 inches, 20 gauge galvanized steel channel.
- .5 Blades: 24 gauge galvanized steel blades, curtain type, recessed out of air stream.
- .6 Fusible link: 165 degrees Fahrenheit.
- .7 Provide duct access doors to service fire dampers for those air transfer openings mounted with ducts.
- .8 Acceptable Manufacturers

- .1 Ruskin – Series I.B.D.2. Style B.
- .2 Nailor Industries – 0120 Type B.
- .3 National Controlled Air (N.C.A.) – F.D. – 80 Type B.
- .4 Tamco
- .5 Price

2.3 Balancing Dampers

- .1 Multi-blade damper: Galvanized steel minimum 16 gauge, provide with quadrants or adjustment rods and lock screw.
- .2 Single blade damper: Galvanized steel minimum 18 gauge, provide with quadrants and lock screw.
- .3 Fabricate splitter dampers of double thickness sheet metal to streamline shape, properly stiffened to avoid vibration. Size on basis of straight air volume proportioning.
- .4 Fabricate single blade dampers for duct sizes to maximum 250 millimeters by 750 millimeters (10 inches by 30 inches).
- .5 Fabricate multi-blade dampers of opposed blade pattern with maximum blade sizes 300 millimeters (12 inches) to 1.8 meters (6 feet). Assemble centre and edge crimped blades in prime coated or galvanized channel frame with approved type hardware.
- .6 Include for the supply and installation of twelve (12) extra balance dampers in installed ductwork pending balance results and comments.

2.4 Turning Vanes

- .1 Factory or shop fabricated double thickness to S.M.A.C.N.A. standards.
- .2 Acceptable Manufacturers:
 - .1 Duro Dyne
 - .2 Ductmate

2.5 Automatic Dampers

- .1 Damper frames and blades shall not be less than 12 gauge, 0.081 inch (2.1 millimeters) extruded aluminium. Channel frame to be 4 inches (101.6 millimeters) deep.
- .2 Blades to be single unit, internally reinforced and connected to frame with a 7/16 inch hexagon rod. Internal hollows to be insulated with 7/8 inch thick polyurethane foam with T. factor of 5.0 per inch. Blades shall be thermally broken. All fresh air intake dampers to be complete with

insulated frame and blade.

- .3 Blade and frame seals to be extruded synthetic rubber secured in an integral slot within the blade extrusion.
- .4 Frame shall be insulated with polystyrene, R. factor of 5.0 per inch.
- .5 Bearings to be comprised of Celcon inner bearing fixed onto a hexagon rod rotating within a Polycarbonate outer bearing inserted into frame, resulting in no metal to metal contact.
- .6 Linkage hardware to be out of air stream and constructed of aluminium and corrosion resistant zinc plated steel, equipped with cup-point trunnion screw for slip-proof grip.
- .7 Dampers shall be suitable for operating in temperatures ranging between - 40 degrees Fahrenheit (minus 40 degrees Celsius) and 165 degrees Fahrenheit (731 degrees Celsius).
- .8 Leakage shall not exceed 0.6 percent of the rated air flow at 10 inches W.G. differential static pressure across the damper.
- .9 This Contractor shall provide all 120-24 volt transformers as required.
- .10 Acceptable Manufacturers:
 - .1 Tamco 9000
 - .2 Ruskin
 - .3 Nailor.

2.6 Damper Actuators

- .1 Damper actuators shall be supplied with the unit by the unit manufacturer or by Controls Contractor under Section 23 09 23 as indicated in the equipment schedules, equipment specifications and controls details.

2.7 Access Doors

- .1 Provide access doors in ductwork to allow cleaning in the bottom of all duct risers, next to outside air intakes and outlets, at each fire damper and plenum and equipment casings to facilitate maintenance and cleaning of all components.
- .2 Construct access doors from double thickness 22 gauge galvanized steel sheets or aluminium in equal strength where required, 25 millimeters apart, with necessary reinforcing inside for rigidity. Fill the 25 millimeters space with glass fibre insulation.
- .3 Make doors airtight with a continuous rubber gasket.
- .4 Access doors to be square or equal to Nailor Ultra-Low Leakage flat oval.

.5 Access Doors shall have minimum two camlocks for sizes up to 250 millimeters (14 inches), and four compression latches for sizes up to 600 millimeters (24 inches).

.6 Acceptable Manufacturers

.1 Price

.2 Nailor

.3 Ruskin

2.8 Flexible Connections

.1 Flexible Connections shall be Duro Dyne heavy glass, U.L.C. listed, non-combustible, waterproof fabric, double coated with neoprene and shall be 150 millimeters minimum width, 0.81 millimeters thick, density of 1.3 kilograms per square meter. Temperature rating shall be minus 40 degrees Celsius (minus 40 degrees Fahrenheit) to plus 90 degrees Celsius (plus 194 degrees Fahrenheit).

.2 Flexible connectors shall be attached to 24 gauge metal strips minimum 75 millimeters (3 inches) wide.

.3 Acceptable Manufacturers:

.1 Duro Dyne

.2 Mercer Rubber Company

2.9 Test Ports

.1 Test ports shall be equal to Duro Dyne TH-1, IP-2, IP-4 to suit application complete with screw in cap, neoprene gasket, insulating plug, and extensions for insulated ductwork.

.2 Acceptable Manufacturers:

.1 Duro Dyne

.2 Ductmate

3 Execution

3.1 Installation

.1 Provide access doors of adequate size to service, maintain, or inspect within duct stream where required. Locations include but are not limited to automatic dampers, fire dampers, and filters. Coordinate installation with General Contractor.

.2 Install flexible connections where rigid duct connects to equipment that is susceptible to vibration and as indicated on drawings.

- .3 Install instrument test ports to allow Pitot tube insertion with cam-action handle.

3.2 Fire Dampers

- .1 Confirm rating of devices with ratings of surfaces or separations.
- .2 Provide fire dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction.
- .3 Fire dampers shall be complete with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- .4 Where access door is located below horizontal fire damper, damper shall be equipped with pull tab release.
- .5 Provide duct access doors to service fire dampers for those air transfer openings mounted with ducts.
- .6 Provide fire stop flaps on air outlets penetrating fire rated membranes or surfaces.

3.3 Balancing Dampers

- .1 Provide balancing dampers, whether shown or required, at points on supply, return and exhaust systems, where branches are taken from larger ducts, for proper air balancing.
- .2 Review balance damper locations with the Balancing Contractor prior to installation. Additional costs to add balance dampers for proper balancing after installation will not be accepted.
- .3 Include for the supply and installation of twelve (12) extra balance dampers in the already installed ductwork pending balance results and comments.

3.4 Turning Vanes

- .1 Install in conformance with S.M.A.C.N.A. standards.
- .2 Install in all square elbows and short radius elbows for supply and return air ductwork.

3.5 Automatic Dampers

- .1 Install opposed blade automatic control dampers as indicated on drawings.
- .2 Opposed Blade Dampers: Use for shut off service, modulating service without companion dampers, throttling services.

- .3 Parallel Blade Dampers: Use for mixing or relief service, variable position service with companion dampers.
 - .4 Coordinate installation of operator and controls with Controls Contractor where applicable.
 - .5 Damper actuators shall be supplied by Controls Contractor under Section 23 09 23 as indicated in the equipment schedules, equipment specifications and controls details.
- 3.6 Access Doors
- .1 Access doors shall be complete with locking latches.
- 3.7 Flexible Connections
- .1 Provide flexible connections on inlet and outlet duct connections of air handling units or other equipment likely to be affected by, or to cause vibration or noise to be transmitted through ductwork.
 - .2 Install in accordance with S.M.A.C.N.A..

End of Section

1 General

1.1 Quality Assurance

- .1 Conform to A.M.C.A. Bulletins regarding construction and testing. Fans shall bear A.M.C.A. certified rating seal.
- .2 Wheels will be balanced in accordance with A.M.C.A. Standard 204-96.
- .3 Polyphase, squirrel cage, single speed N.E.M.A./E.E.M.A.C. Design A or B induction motors, between 1 horsepower and 200 horsepower whether in packaged equipment or not, shall comply with the current requirements of the Ontario Hydro Efficiency Standards Regulation, and specifically, C.S.A. C390- 93 Energy Efficiency Test Methods for Three Phase Induction Motors.

1.2 Submittals

- .1 Shop Drawings:
 - .1 Refer to Section 23 05 01 – H.V.A.C. General Requirements.
 - .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
 - .3 Shop drawings shall include:
 - .1 Manufacturer and model numbers
 - .2 Performance data
 - .3 Fan curves and sound data, with fan and system operating point plotted on curves
 - .4 Calculations and technical data to support drive selection
 - .5 Fan details, isolation and details
 - .6 Cabinet construction, gauge, access doors, fasteners
 - .7 Maintenance requirements
 - .8 Conformance to above reference standards
 - .4 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.
- .2 Operation and Maintenance Data:
 - .1 Provide operation and maintenance literature indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
 - .2 Operation and maintenance data shall be included in the

maintenance manual.

1.3 Job Conditions

- .1 Do not operate fans for any purpose, temporary or permanent until ductwork is clean, filters in place, bearings lubricated and fan has been run under close supervision

1.4 Acceptable Manufacturers

- .1 Manufacturers of exhaust fans whose products are approved in principle, but subject to requirements of drawings and specifications are:
 - .1 Cook
 - .2 Greenheck
 - .3 Penn
 - .4 Carnes
 - .5 Big Ass Fans
- .2 Alternatives: Equivalent fan selections shall not decrease motor power, increase noise level, increase tip speed by more than 10% or increase inlet air velocity by more than 20% from that specified.

2 Products

2.1 General

- .1 Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.
- .2 Provide balanced variable sheaves.
- .3 Fans shall be capable of accommodating static pressure variations of plus 10 percent with no objectionable operating characteristics.
- .4 Unless otherwise noted, include all motors and drive combinations with electrical characteristics as detailed elsewhere.
- .5 Fan hubs and sheaves shall be keyed to shafts for fans over $\frac{3}{4}$ horsepower. Use of flat ground surface and set screws are not approved.
- .6 Select variable and adjustable pitch sheaves unless otherwise specified, so that required rpm is obtained with sheaves set at mid-position, and approximate speed adjustment of 25 percent.
- .7 Rate drive as recommended by manufacturer, but minimum 1.5 times power rating of the motor. Submit calculations and technical data with shop drawings, to support drive selection.

- .8 Fans shall bear the A.M.C.A. Certified Ratings Seal for both sound and air performance.

2.2 Cabinet Fans

- .1 Fans shall be of the centrifugal driven in-line type. The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.
- .2 Cabinet shall be heavy gauge metal with galvanized or baked enamel finish.
- .3 Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.
- .4 The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances.
- .5 Motors shall be variable speed heavy duty ball bearing type. Motors and drives shall be mounted out of the airstream. Motors shall be readily accessible for maintenance.
- .6 Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum catalogued operating speed.
- .7 Accessories:
 - .1 N.E.M.A. 1 pre-wired disconnect switch.
 - .2 Multi-blade, rattle free, backdraft damper with felt lined blade edges.
 - .3 Time delay off switch where indicated.
 - .4 Controls as indicated on drawing schedule.
- .8 Spare Parts
 - .1 Supply one (1) complete set of spare belts for all belt driven fans.

2.3 Ceiling Mounted Fans

- .1 Ceiling mounted fans shall be low sone type equal to manufacturer and model as per schedule and shall not exceed sone value as indicated.

2.4 Propeller Fans

- .1 Fan shall be manufactured at an I.S.O. 9001 certified facility. Fan shall be listed by Underwriters Laboratories (U.L. 705) and U.L. listed for Canada

- (c.U.L. 705). Fan shall bear the A.M.C.A. certified ratings seal for sound and air performance.
- .2 Fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The motor shall be mounted on a 12 gauge steel wire guard. The wire guard shall be bolted to a minimum 14 gauge wall panel with continuously welded corners and an integral venturi. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design C.F.M. and static pressure. Unit shall be shipped in I.S.T.A. certified transit tested packaging.
 - .3 All steel fan components shall be treated with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a 1.5 to 2.5 mil thick baked powder finish. Paint must exceed 1,000 hour salt spray under A.S.T.M. B117 test method.
 - .4 Propeller shall have aluminum blades riveted to a painted steel hub. The hub shall be securely fastened to the motor shaft utilizing two setscrews. Propeller shall be balanced in accordance with A.M.C.A. Standard 204-05.
 - .5 Motor shall be an electronically commutated motor rated for continuous duty and furnished either with internally mounted potentiometer speed controller or with leads for connection to 0-10 V.D.C. external controller.
- 3 Execution
- 3.1 General
- .1 Install as per manufacturer's instructions.
 - .2 Install fans as shown, with resilient or spring mountings and fan restraining snubbers and flexible electrical leads. Refer to 23 05 47.
 - .3 Align shafts, belt drive and motor, adjust belt tension, ensure all set screws are tight, and check motor rotation before start-up.
 - .4 Protect motors and fans during construction and rotate fans, by hand, every month between delivery and acceptance of building.
 - .5 Install fans with flexible connections on inlet ductwork and on discharge ductwork in accordance with Section 23 33 00.
 - .6 Adjust variable pitch fan/motor sheaves during balancing to achieve specified air quantities.
- 3.2 Cabinet Fans
- .1 Install in conformance with manufacturer's requirements and recommendations.

- .2 Provide U-Channel, 3/8 inch rod and vibration isolation for mounting.
- .3 Provide guard on any exposed fan inlet or outlet.
- .4 Supply and install sheaves as necessary for final air balancing for belt driven fans.

3.3 Propeller Fans

- .1 Install in conformance with manufacturer's requirements and recommendations.
- .2 Inspect fasteners and setscrews, particularly those used for mounting the unit, and tighten as necessary.
- .3 Rotate the prop to ensure it does not rub against the venturi.

End of Section

1 General

1.1 Summary

.1 Section Includes

.1 The ceiling-mounted circulation fan is the model scheduled with the capacities indicated. The fan shall be furnished with mounting hardware and a remote control as manufactured by Big Ass Fans.

.2 Summary of Work

.1 Installation of the fan, wireless network, miscellaneous or structural metal work (if required), field electrical wiring, cable, conduit, fuses, and disconnect switches, other than those addressed in the installation scope of work, shall be provided by others. Installation services are available through Big Ass Fans. Consult the appropriate installation scope of work for information on the available installation options, overview of customer and installer responsibilities, and details on installation site requirements.

1.2 Related Sections

.1 21 00 00 Fire Suppression

.2 23 00 00 Heating, Ventilating, and Air Conditioning (H.V.A.C.)

.3 26 00 00 Electrical

1.3 References

.1 International Organization for Standardization (I.S.O.)

.2 National Electrical Code (N.E.C.)

.3 National Fire Protection Association (N.F.P.A.)

1.4 Submittals

.1 Shop Drawings: Drawings detailing product dimensions, weight, and attachment methods

.2 Product Data: Specification sheets on the ceiling-mounted fan, specifying electrical and installation requirements, features and benefits, and controller information

.3 Revit Files: Files provided for architectural design

.4 Installation Guide: The manufacturer shall furnish a copy of all installation, operation, and maintenance instructions for the fan. All data is subject to change without notice.

.5 Schedule

1.5 Quality Assurance

- .1 Manufacturer Qualifications
- .2 The fan and any accessories shall be supplied by Big Ass Fans, which has a minimum of twenty (20) years of product experience.
- .3 I.S.O. 9001-compliant

1.6 Delivery, Storage, and Handling

- .1 Deliver product in original, undamaged packaging with identification labels intact. The fan shall be new, free from defects, and factory tested.
- .2 The fan and its components must be stored in a safe, dry location until installation.

1.7 Warranty

- .1 The manufacturer shall replace any products or components defective in material or workmanship, free of charge to the customer (including transportation charges within the USA, FOB Lexington, KY), pursuant to the complete terms and conditions of the Big Ass Fans Warranty in accordance to the following schedule:

Application	Period of Coverage
Residential	3 years
Non-Residential	3 years

Labor to repair the defect will be provided free of charge at the Big Ass Fans service center for defects arising during the Warranty Period.

2 Products

2.1 Manufacturer

- .1 Delta T L.L.C., dba Big Ass Fans, PO Box 11307, Lexington, Kentucky 40575.
Phone (877) 244-3267. Fax (859) 233-0139. Website:
www.bigassfans.com

2.2 Big Ass Fans es6

- .1 Complete Unit
 - .1 Quality: The fan shall display good workmanship in all aspects of its construction. Field balancing of the airfoils shall not be necessary.
 - .2 Colors: Airfoil colors may be selected by the architect or owner as described in 2.2.C, "Airfoils."

- .3 Optional Accessories
 - 1. The Chromatic Uplight™ may be selected at the time of order.
 - 2. An L.E.D. light that attaches to the bottom of the fan may be selected at the time of order.
- .2 Mounting System
 - .1 Universal Mount
 - 1. The universal mount shall be suitable for flat or sloped ceilings with heights ranging from 9–18 feet (2.7–5.5 meters).
 - 2. The fan shall be equipped with a mounting bracket, canopy, mounting ball and wedge, downrod, wiring cover, motor hub, and mounting hardware.
 - 3. The fan shall be available with a diameter of 60 inches (152 centimeters), 72 inches (183 centimeters), or 84 inches (213 centimeters).
 - 4. The fan shall include one (1) downrod. The length of the downrod may be selected at the time of order.
 - .1 A 7-inch (178-millimeter), 20-inch (508- millimeters), or 32-inch (813- millimeters) downrod shall be included with the fan.
 - .2 A 48-inch (1219- millimeters) or 60-inch (1524- millimeters) downrod shall be available for purchase separately.
 - .3 Airfoils
 - .1 The fan shall be equipped with six airfoils spanning a total diameter of 60 inches (152 centimeters), 72 inches (183 centimeters), or 84 inches (213 centimeters), as specified by the architect or owner.
 - .2 Airfoils shall be made of aircraft-grade aluminum.
 - 1. Airfoils shall be available in Black or White.
 - 2. Airfoils shall be suitable for indoor and covered outdoor (inland) spaces.
 - .4 Motor
 - .1 The fan shall have an electronically commutated motor (E.C.M.)

rated for 100–277 V.A.C., single phase.

- .2 The motor shall draw 21.8–23.7 watts depending on the speed at which the fan is operated and if a light is installed.
- .3 The fan shall be designed for continuous operation in ambient temperatures of 32–104 degrees Fahrenheit (0–40 degrees Celsius) and a humidity range of 20–90 percent (non-condensing).
- .4 The fan's motor unit and motor unit trim shall be available in a Black or White finish, as specified by the architect or owner.
- .5 **Safety Cable**
 - .1 The fan shall be equipped with a safety cable that provides an additional means of securing the fan assembly to the building structure. The safety cable shall be 1.5 millimeters in diameter and fabricated of aircraft steel.
 - .2 Field construction of safety cables is not permitted.
- .6 **Big Ass Fans Mobile App**
 - .1 The fan shall be able to wirelessly connect to local Ethernet networks or host a network. The fan's Bluetooth® capability shall permit over-the-air firmware updates.
 - .2 Fan control features shall be managed by users via the Big Ass Fans mobile app. The Big Ass Fans mobile app shall be supported by Android™ and iOS® mobile devices.
 - .3 **Mobile App Control Modes**
 1. **Motion Sensor.** The fan and light automatically turn on and off depending on whether motion is detected in the room.
 2. **Rooms.** Enables users to group multiple fans in the same space for synchronized operation. Users shall be able to use the Big Ass Fans mobile app to automate fan and light functions or adjust settings manually.
 3. **Manual Speed Control.** Speed settings range from 0 (Off) to 7 (High).
 4. **Manual Light Control.** The optional Chromatic Uplight and L.E.D. light have adjustable brightness and On and Off settings, as well as the ability to be controlled by the motion sensor feature. The mobile app shall also provide control of the Chromatic Uplight's Night Light mode and optional UV-C Clean Mode. For fans with the Chromatic Uplight, see 2.2.I, "Chromatic Uplight." For fans with an L.E.D. light, see 2.2.J,

“L.E.D. Light.”

5. Amazon Alexa Integration. Enables the use of Amazon Alexa to control the fan and light(s).
 6. Google Assistant Integration. Enables the use of Google Assistant to control the fan and light(s).
- .7 Display and Sound
- .1 Changes to fan settings shall be confirmed with auditory feedback (a beep) and/or visual indication.
- .8 Remote Control
- .1 The fan shall be equipped with a compact Bluetooth remote control that allows intuitive operation of the fan speed and light brightness in the following modes:
 1. Fan speeds 0 (Off) through 7 (High)
 2. Auto Mode
 3. Light brightness 0–100 percent
 - .2 The remote shall be 1.5” wide by 5.7” tall by 0.8” thick (39 millimeters wide by 146 millimeters tall by 20 millimeters thick) and shall operate on a CR 2450 3 V lithium battery (included).
- .9 Chromatic Uplight (Optional)
- .1 The fan shall be equipped with the Chromatic Uplight, as specified by the architect or owner.
 - .2 The Chromatic Uplight shall be installed on top of the fan motor hub for upward-directed lighting.
 - .3 The Chromatic Uplight kit shall include an L.E.D. light module that shall secure to the fan downrod with two set screws.
 - .4 The Chromatic Uplight shall allow the user to adjust the color temperature to 2700 K., 4000 K., or R.G.B. color changing and shall have night light functionality. The user shall be able to change the R.G.B. color setting to red, orange, yellow, green, blue, purple, or pink.
 - .5 The Chromatic Uplight shall have a standard lumen option of 1,845 lumens (2700 K. setting) or 1,984 lumens (4000 K. setting) and shall be capable of dimming down to 1 percent.
 - .6 As an upgrade, the Chromatic Uplight shall also include UV-C L.E.D.s, as specified by the architect or owner. The UV-C L.E.D.s

shall emit UV-C light while the fan is spinning.

.7 For safety, the optional UV-C L.E.D.s shall only be able to be turned on while the fan is spinning.

.10 L.E.D. Light (Optional)

.1 The fan shall be equipped with an L.E.D. light, as specified by the architect or owner.

.2 The L.E.D. light kit shall include an L.E.D. light module with a diffused translucent lens.

.3 The L.E.D. light shall use a twist lock mechanism to attach to the bottom of the fan for downward-directed lighting.

.4 The L.E.D. light shall allow the user to adjust the color temperature to 2700 K or 4000 K.

.5 The L.E.D. light shall have a standard lumen option of 1,770 lumens and shall be capable of dimming down to 1 percent.

3 Execution

3.1 Preparation

.1 The fan location must have an appropriate ceiling-mounted outlet box marked "Acceptable for Fan Support." If there is not an appropriate outlet box already installed at the location, one must be installed on a ceiling joist or beam and be properly wired. Additional mounting options may be available. Consult the installation guide for additional details.

.2 The fan location must be free from obstacles such as lights, cables, or other building components.

.3 Check the fan location for proper electrical requirements. Consult the installation guide for appropriate circuit requirements.

3.2 Installation

.1 Install the fan according to the manufacturer's installation guide, which includes acceptable mounting methods.

.2 Required Distances

.1 For 60-inch (152-centimeters) and 72-inch (183-centimeter) fans, the airfoils must be at least 7 feet (2.1 meters) above the floor.

.2 For 84-inch (213-centimeter) fans, the airfoils must be at least 8 feet (2.4 meters) above the floor.

.3 The airfoils must have at least 2 feet (0.6 meters) clearance from all obstructions.

- .4 The fan shall not be located in close proximity to the outputs of H.V.A.C. systems or radiant heaters.
- .3 Install and set up the Big Ass Fans mobile app according to the manufacturer's instructions.

End of Section

1 General

1.1 Related Documents

- .1 Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.2 Summary

- .1 Provide all labor, materials, and equipment necessary to put in working operation a complete turnkey vehicle exhaust removal system to remove both diesel and automotive exhaust gases and particulate of operating vehicles within the confines of specified fire station(s). All necessary controls, motors, fittings, ductwork, blower(s), labor and all other equipment and materials specified shall be part of the work.

- .2 Section Includes:

- .1 Manufacturer
- .2 Rail Material
- .3 Top Mounting Suspension
- .4 Support Legs
- .5 Optional Hydraulic Brake System
- .6 Rail Splicing Joint
- .7 Middle Rail Duct Connection
- .8 Trolley Assembly
- .9 Upper Flexible Hose
- .10 Mid Hose
- .11 Lower Hose Assembly
- .12 Safety Disconnect Coupling Handle
- .13 Collection Nozzle Assembly
- .14 Hose Saddle
- .15 Electrical Controllers
- .16 Electrical System
- .17 Air Moving Devices
- .18 Ductwork System

- .3 All items of equipment and materials described in these specifications are to be furnished installed and placed into proper operating condition in accordance with good practice and manufacturer's written or published instructions.
 - .1 The vehicle exhaust removal system shall provide virtually 100 percent complete evacuation of all diesel fumes at the source from start up to exit of the apparatus from the fire station. The vehicle exhaust removal system shall be capable of delivering complete coverage for bays up to 120 feet (36.5 meters) in length. The system must be able to accommodate drive through and back-in bays to meet all the needs of the fire department.
 - .2 System must be designed and installed to N.I.O.S.H. recommendation, specifying that occupational exposures to carcinogens be limited to the lowest feasible concentration. Exposure in the human breathing zone should be limited to lowest feasible level, without any time delay required for the system to effectively capture the diesel fumes.
 - .3 System must also be capable to provide virtually complete capture and evacuation of carbon monoxide emitted as part of the vehicle exhaust.
 - .4 Systems that solely use filters, in which diesel particulate may accumulate, and that would potentially have to be treated as hazardous materials, will not be accepted.
 - .5 System must meet the guidelines for the International Mechanical code for Source Capture Systems. Such system is defined as a mechanical exhaust system designed and constructed to capture air contaminants at their source and to exhaust such contaminants to the outdoor atmosphere.
 - .6 The system shall not affect personnel boarding the apparatus. Hose loops shall not hang any lower than six feet (1.8 meters) from the bay floor. The hose assembly shall not come into contact with the vehicle other than one connection point to the vehicles tailpipe. The hose assembly shall not touch or drag on the bay floor.
 - .7 The exhaust system shall not block doorways, exits, and aisles in the apparatus bay, which could endanger the welfare of fire personnel or visitors.
 - .8 The exhaust system shall not need to be disconnected from the vehicle while shore lines are connected, during battery

charging, or washing of the vehicle, as with other types of systems.

- .9 To protect the apparatus electrical system from possible damage, the system bid shall not incorporate any type of electromagnetic device that requires the apparatus to be utilized as an electrical ground for systems operation.

When reviewing requests for substitutions are being reviewed, no exception to the following requirement should be allowed. Due to the harmful effects of diesel exhaust, the system must be designed and capable of capturing virtually 100% of the exhaust gas and virtually 100% of the particulate even in the event of a complete power failure. The system shall not detach itself from the apparatus for any reason during a power failure other than normal exiting of the apparatus bay. System shall discharge exhaust outside the station even in the event of a power failure.

- .10 The system shall capture the exhaust gases and particulate directly from the tailpipe of the apparatus by a direct connected "visible" high temperature rated hose. Particulates emitted from the apparatus are known to be heavier than air and therefore must be captured by a directly connected hose with a tight seal, as loose nozzles or air filters cannot capture these heavy particulates. The particulates have been documented to be the main breathable carcinogen in diesel exhaust, and therefore are the primary concern of the fire department to capture virtually 100 percent of these particulates.

1.3 Submittals

- .1 Product Data: Indicate manufacturer's model number, technical data including description of components and static pressure/air flow chart, and installation instructions.
 - .1 Details of wiring for power differentiating between manufacturer-installed and field-installed wiring.
- .2 Closeout Submittals: Operation and Maintenance data manual including spare parts list.

1.4 Quality Assurance

- .1 Engage a factory certified installer to perform work of this Section who has completed installations similar in design and extent to that indicated for this Project, and who has a record of successful in-service performance. No Exceptions.
- .2 The manufacturer must be an I.S.O. 9001:2015 certified www.iso.org manufacturer with certification issued to a United States facility, this shows a

commitment to delivering the highest quality service and products to the end user. Manufacturer shall be U.L. and C.U.L. Certified www.ul.com/database/ and certified by the Air Movement and Control Association (A.M.C.A.) www.amca.org/search.htm to ensure quality, consistency and reliability of products. All certification documents shall be provided and attached to the bid proposal. No exceptions.

- .3 The manufacturer shall be D.R.C. Conflict Free. Manufacturers shall only supply products that do not contain minerals that directly or indirectly finance or benefit armed groups in the Democratic Republic of the Congo or an adjoining country. Please refer to the Dodd-Frank Wall Street Reform and Consumer Protection Act, Section 1502.
 - .4 Engage a firm experienced in manufacturing vehicle exhaust removal systems similar to that indicated for this project and with a record of successful in-service performance.
 - .5 Conduct conference at project site. Review methods and procedures related to vehicle exhaust removal system installation.
 - .1 Review access requirements for equipment delivery.
 - .2 Review equipment storage and security requirements.
 - .3 Inspect condition of preparatory work performed by other trades.
 - .4 Review structural loading limitations.
 - .5 Review that all components specified in this Section and related components specified in other Sections are accounted for.
- 1.5 Delivery, Storage and Handling
- .1 Packing, Shipping, Handling and Unloading: Deliver components with protective packaging. Store in original protective crating and covering and in a dry location.
- 1.6 Project/Site Conditions
- .1 Existing Conditions: Verify dimensions installation areas by field measurements
- 1.7 Coordination
- .1 Coordinate layout and installation with other work, including light fixtures, fixed equipment and work stations, H.V.A.C. equipment, radiant tube heaters and fire-suppression system components.
 - .2 Coordinate location and requirements of service-utility connections.
- 1.8 References
- .1 Air Movement and Control Association International, Incorporated

- .1 A.M.C.A. Standard 500-D-98, "Laboratory Methods of Testing Dampers for Rating".
- .2 A.S.T.M. International.
 - .1 Stainless Steel:
 - .1 A240/A240M-04 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - .2 Bright, Directional Polish: Number 4 finish.
 - .2 Aluminum:
 - .1 B209/209M-04 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - .2 Powder-Coated Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness
 - .3 Galvanized Steel:
 - .1 A653/A653M-04a Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .4 ArmorGalv
 - .1 Specifications: A.S.T.M. A 1059 M
 - .2 ArmorGalv is a thermal diffusion galvanizing, duplex coating with galvanic separation/insulation properties.

1.9 Bidder Qualifications

- .1 Bids will only be accepted from companies that have an established reputation in the business of system design, turnkey installation and long-term service of Automatic Emergency Response Vehicle Exhaust Removal Systems for a minimum of no less than five (5) years. Bidder shall be a registered corporation, partnership or sole proprietorship within the State where the installation is to take place. Bidder must have a current and valid state contractor's license, if required by the state for the work that is being bid. Bidder shall show proof that the system specified in this Bid Document has been field tested and proven by supplying a list of references with no less than 50 fire stations with systems installed by bidder (with comparable emergency and non-emergency run rates) within a 200 mile (322 kilometer) radius of municipality seeking bid. References

shall be submitted with the Bid Document and shall include phone numbers and contact names.

1.10 Manufacturer Qualifications

- .1 Bids shall only be accepted by bidders supplying equipment from manufacturers that have an established reputation in the business of manufacturing Automatic Emergency Response Vehicle Exhaust Removal Systems for a minimum of no less than fifteen (20) years. The manufacturer must be a I.S.O. 9001:2015 Certified in the United States www.iso.org, U.L. and C.U.L. Certified www.ul.com/database/ and certified by the Air Movement and Control Association (A.M.C.A.) www.amca.org/search.htm to ensure quality, consistency and reliability of products. Certification documents shall be provided and attached to the bid proposal. No exceptions. Where the requirement calls for a packaged exhaust system to be provided, all items shall be the product of the manufacturer. The product offering must be a product that has been offered by that manufacturer for a minimum period of twenty (20) years. No prototypes or private label products by other manufacturers will be allowed. System bid shall have a life of service of no less than 10 years to establish proof of quality, longevity and service. No exceptions.

2 Products

2.1 Manufacturer

.1 Plymovent Corporation

5 Corporate Drive

Cranbury, New Jersey 08512

U.S.A.

T: (609) 395-3500

T: (800) 644-0911

F: (609) 655-0569

WEB: info@plymovent.com

Local Sales Contact;

Darren Chaulk

Tin Knockers Industrial Ltd.

500 Wentworth St. East, Unit 15

Oshawa, Ontario L1H 3V9

T: (905) 432-9702

email: darren@thetinknockers.com

.2 Nederman Canada

5865 McLaughlin Road Unit 1, Mississauga, ON Canada L5R 1B8

Mobile: 416 779 7845

www.nederman.com

2.2 Rail Material

- .1 Rail Material: One-piece continuous extruded aluminum rail in a minimum length of 19 feet (5.8 meters) in an effort to reduce the points of leakage due to joints or connections. The construction profile shall be of a round profile type with a flat top, diameter of 6 ½ inches (165 millimeters) with a rail thickness of 0.175 inch (4.4 millimeters). The bottom portion of the rail shall have a continuous slot to accept a rubber lip seal. Rail Material: Aircraft aluminum alloy Type AA-6063 (A.S.T.M. B209/B209M). Aluminum Rail: Extruded as a one piece design to maximize the structural integrity of the rail and to minimize joints. Extruded into the rail profile shall be all necessary mounting guides, which will allow for support of the rail mounting hardware and

airline support cable. Mounting Channels: Provided continuously along both sides of the rail extrusion in order the proper positioning of all required mounting supports in accordance with codes. The rail shall allow the trolley/hose assembly to glide to the door threshold in a safe and effective manner. The extruded rail channel shall allow the whole rail to remain rigid and shall provide an area to attach bolts for splicing additional rails together for systems over 19 feet (5.8 meters) long. The overall extruded rail lengths shall be 19 feet (5.8 meters) standard. Rail System: Equipped with an optional hydraulic braking system that limits travel of flex hose/trolley as the vehicle exits the building. Hydraulic Brake: Incorporated into the end cap of the suction rail.

2.3 Top Mounting Suspension

- .1 Top Mounting Suspension: Designed to attach with 2 mounting cleats to the mounting slots that are extruded into the rail profile. The top suspension mount support shall consist of 2 extruded Aircraft aluminum alloy Type AA-6063 (A.S.T.M. B209/B209M) and provided with 2 pre-punched $\frac{3}{8}$ inch (10 millimeter) holes for attaching to the aluminum leg assembly and 1 pre-punched $\frac{1}{4}$ inch (6 millimeter) hole for keying the leg assembly to the rail.

2.4 Support Legs

- .1 Support Leg and Mounting Feet: Manufactured and provided by the supplier of primary exhaust removal system (Equipment Manufacturer). Leg Material: Aircraft aluminum alloy Type AA-6063 (A.S.T.M. B209/B209M). Supports shall come standard in 19 feet (5.8 meters) lengths. A minimum of one support with appropriate bracing shall be provided for every 10 linear feet (3.0 meters) of track profile. The support legs shall consist of a square tubular profile with dimensions no less than 2 inch (50.8 millimeters) O.D. by 0.1 inch (2.5 millimeters) with $\frac{3}{8}$ inch (10 millimeters) fastening hardware provided. Vertical Adjustable Mounting Foot: Capable of attaching the leg assembly to a ceiling with a 30 degree pitch, complete with a slider bar and $\frac{3}{8}$ inch (10 millimeters) hardware necessary for mounting the horizontal track to the mounting channel system. Horizontal Adjustable Mounting Foot: Capable of attaching the leg assembly to a wall, complete with a slider bar and $\frac{3}{8}$ inch (10 millimeter) hardware necessary for mounting the horizontal track to the mounting channel system. Support Leg: Equipped with round tubular zinc-plated steel knee brace with pressed ends in standard lengths of 20 inches (508 millimeters), 30 inches (762 millimeters) and 72 inches (1.8 meters). Angle completely adjustable to the leg support and mounted perpendicular and parallel to direction of the track. Typical Support

Angle: 45 degrees from the centerline of the factory provided support leg. The standard leg shall be capable of meeting a Seismic 4 requirement. "Uni-strut", all-thread rod, and/or chains may not be used in place of a leg assembly as sole support of the system. Vertical support and bracing shall be provided to safely secure the rail profile in accordance with building code and seismic standards which may apply. A minimum of one support with appropriate bracing shall be provided for every 10 feet (3 meters) to 12 linear feet (3.7 meters) of rail profile.

2.5 Hydraulic Brake System

- .1 Hydraulic Brake System: Incorporated into the EXIT end cap of the suction rail profile. The hydraulic brake system must incorporate a hydraulic shock capable of reducing the forward impact of 1 to 4 suction trolleys which may be installed now or in the future to the exhaust rail system. This hydraulic shock shall be secured to a steel end cap fabricated of 6 ¼ inch (159 millimeters) diameter steel tubing with a wall thickness of 0.156 inch (4 millimeters) welded to a 0.156 inch (4 millimeters) steel plate with formed 90 degree side rails for rigidity. The end cap shall have a removable circular end plate to facilitate an end feed duct connection and shall be a black powder coated finish. The hydraulic shock shall be capable of reducing to a full stop the trolleys in less than 4 inch (102 millimeters), without physical damage to either the rail profile or trolley that it is stopping.

2.6 Rail Splicing Joint

- .1 Rail Splicing Joint: The splice joint shall be formed aluminum extrusion equal to the internal diameter of the suction rail profile. The splice shall have a wall thickness of no less than .190 inches (4.8 millimeters) in thickness and a length of no less than 8 inches (203.2 millimeters) from end to end. The rail splice shall be safely secured by no less than 12- ⅜ inch (10 millimeters) by 1 ½ inch (38 millimeters) bolts, washers and nyloc nuts. Each bolt shall pass through the exterior of the rail profile and splicing joint and be secured on the inside by a washer and nyloc nut. Self-tapping bolts or screws are not acceptable.

2.7 Middle Rail Duct Connection

- .1 Middle Rail Duct Connection: The rail duct connection shall be rectangular to an 8 inch diameter round transition fitting fabricated from 24 gauge galvanized steel (A.S.T.M. A653) with a double rubber U style lip seal. The rectangular slot shall be 19 inches (482.6 millimeters) long by 1 ¾ inch (44.5 millimeters) high with a ⅜ inch (9.5 millimeters) external flange to slide into the rail profile and secured with self-tapping screws.

2.8 Trolley Assembly

- .1 Trolley Assembly: Gantry type trolley with sealed bearing loaded wheels designed to roll inside the internal rail profile flange. The trolley chassis shall be aluminum and epoxy coated with a black finish. The chassis shall be fitted with a tapered suction cone. Rubber Sealing Lips: Vulcanized Teflon strip covering 1 ½ inch (38 millimeters) of the bottom edge of the sealing lip which shall contact with (5) five Teflon rollers on each side of the suction cone to minimize resistance between the suction cone and the rubber sealing lips. The suction cone transition shall be a tapered slot design which shall fit inside the suction rail profile. The tapered slot shall be equal or exceed in area the diameter of exhaust ventilation hose to which it is attached. Trolley Assembly: Equipped with rubber impact bumpers at both the front and rear of the trolley chassis to eliminate metal to metal contact which could damage the trolley assembly. There shall be a system balancer assembly provided to aid in the delivery of the hose to the exit door. Balancer Assembly: Self-adjusting weight spring tension balancer with a lifting capacity of no less than 31 pounds (14 kilograms). The balancer shall have a minimum diameter steel cable of .080 inch (2 millimeters) and have a safety link connection.

2.9 Upper Flexible Hose

- .1 Flexible S.T. (Standard Temperature) exhaust hose manufactured for the sole purpose of venting high temperature exhaust gases. Flexible Upper Hose: Designed strictly for the harsh environment of rapid response and auto-release of a vehicle exhaust tailpipe. Hose: Shall be 4 inch (100 millimeters) diameter with a length of 4 feet (1.2 meters), without joining or splicing connections. Hose Material: High temperature synthetic rubber impregnated into a high temperature laminated fabric with a mechanically crimped connection around a coated steel wire. This construction of hose must be capable of operating at continuous temperatures of 400 degrees Fahrenheit (204 degrees Celsius) and intermittent temperatures of 500 degrees Fahrenheit (260 degrees Celsius), such as are experienced when pump checks are performed inside the fire station. Protective Clip Cover: This shall be accomplished in a fashion, which eliminates any possibility of personnel coming in contact with an exposed hot metal helix and be provided in a safety yellow color. The bend radius of the high temperature hose shall be no less than 1.5 times the diameter of hose to ensure that hot gases are not restricted as they pass through the system. Hoses utilizing an exposed metal helix will not be acceptable due to potential burn hazard and/or shock hazard from being utilized as a grounded, grounding or current carrying conductor for electromagnet connections. No exceptions will be allowed.

2.10 Mid Hose

- .1 S.T. (Standard Temperature) Mid Hose: Designed strictly for the harsh environment of rapid response and auto-release from a vehicle exhaust tailpipe. Semi rigid hose: Shall be 4 inch (100 millimeters) diameter by 10 feet (3 meters) long section of yellow and black hose identical in appearance to the lower hose assembly and extending from the metal saddle to the S.D.C.H. Hose Material: High temperature synthetic rubber impregnated into a high temperature laminated fabric with a minimum overlapping thickness of 2 7/16 inches (62 millimeters). This construction of hose must be capable of operating at continuous temperatures of 400 degrees Fahrenheit (204 degrees Celsius) and intermittent temperatures of 500 degrees Fahrenheit (260 degrees Celsius), such as are experienced when pump checks are performed inside the fire station. An independent third party test report shall be submitted with bid as proof of claim. Wire Helix: Bound and protected in laminations of hose winding. This shall be accomplished in a fashion, which eliminates any possibility of personnel coming in contact with an exposed hot metal helix. The hose shall further protect the internal wire helix from heat buildup and in turn add increased visibility to personnel. Wear Strip: 9/16 inch (14.2 millimeters) wide and be provided in a safety yellow color. Hoses utilizing an exposed metal helix will not be acceptable due to potential burn hazard and/or shock hazard from being utilized as a grounded, grounding or current carrying conductor for electromagnet connections. No exceptions will be allowed.

Hoses utilizing an exposed metal helix will not be acceptable due to potential personnel burn hazard. No exceptions will be allowed.

2.11 Lower Hose Assembly

- .1 H.T. (High Temperature) Lower Hose: Semi rigid 4 inches inch (100 millimeters) diameter by 2 feet (610 millimeters) long section of yellow and black hose identical in appearance to the upper hose. This construction of hose must be capable of transporting exhaust at continuous temperatures of 900 degrees Fahrenheit (482 degrees Celsius) and intermittent temperatures of 1,050 degrees Fahrenheit (566° C). An independent third party test report shall be submitted with bid as proof of claim. Wire Helix: Bound and protected in laminations of high temperature material. This shall be accomplished in a fashion, which eliminates any possibility of personnel coming in contact with an exposed hot metal wire helix. The hose shall further protect the internal wire helix from heat buildup and in turn add increased visibility to personnel. High Temperature Wear Strip: 9/16 inch (14 millimeters) wide and be provided in a safety yellow color.

Shall support the magnetic collection nozzle and stainless steel reducing elbow in a semi rigid fashion to allow for the operator to place hose collection nozzle onto the tailpipe without bending over. The lower hose is the only section of hose which shall disconnect from the upper hose assembly and act as a safety disconnect in the unlikely event the nozzle gets entangled. Hoses utilizing an exposed metal helix will not be acceptable due to potential personnel burn hazard. No exceptions will be allowed.

2.12 Safety Disconnect Coupling Handle

- .1 Safety Disconnect Coupling Handle (S.D.C.H.): An injection molded composite body with a 4 inch (100 millimeters) diameter hose connection. A 360 degree rubber bumper to protect the vehicle and disconnect from wear shall be incorporated in the design of the system. Coupling: Consists of a aluminum inner flange collar connected by a patented easy reconnect mechanism. The release tension of this device shall be preset at 102 pounds of force (450 N.) and easily reconnected with only 3 pounds of force (13 N.)

2.13 Collection Nozzle Assembly

- .1 Collection Nozzle Assembly: Provides a substantially air tight seal around exhaust tail pipe when connected thus allowing for virtually 100 percent source capture. The seal shall limit escape of life threatening exhaust gases.
- .2 The Magnetic Nozzle shall be engineered and designed with rare earth magnets that are strategically positioned on the face of the collection nozzle. The Magnetic Nozzle shall be coated with BlackArmour high temperature, wear and corrosion resistant duplex coating, to limit the effects from corrosive road treatment chemicals. The collection nozzle shall also incorporate a protective rubber safety cover to avoid damage to vehicle and surroundings. The magnets shall only make contact with the face of the tailpipe adapter located on the tailpipe. The reducing elbow that connects the flexible hose to the collection nozzle shall be fabricated using continuous welded construction and shall be made from polished 304 stainless steel. The angle of transition shall be no less than or greater than 67 degrees from the centerline of the reducer. The stainless steel reducer shall incorporate a primary expanded metal debris screen, which is permanently affixed by weld joints to the inside opening of collection nozzle. The collection nozzle shall be connected from a upright standing position by the user without bending over. Since this item is a point of safety for both personnel and the system itself. No exception will be allowed.

- .3 The TopGrade Conical Tailpipe Adapter shall be constructed from a high temperature, corrosion resistant, magnetic stainless steel, to limit the effects from extremely aggressive corrosive road treatment chemicals. The conical tailpipe adapter shall be of a self-aligning “Click and Seal” design for aiding in the connection and release of the collection nozzle from the fire apparatus.

2.14 Hose Saddle

- .1 Metal Hose Suspension Saddle: Fabricated of steel and powder coated with a black matte finish specifically manufactured for the sole purpose of suspending high temperature exhaust ventilation hose in a rapid response and auto-release application. The design of the saddle shall smoothly transition the direction of the hose during its travel along the track. Securing clamps shall be provided including a link fastener, for the purpose of attaching it to the balancer

2.15 Electrical Controllers

- .1 Controller: Built and supplied by a U.L. and C.U.L. recognized and listed exhaust system manufacturer. Controller shall carry the U.L. and C.U.L. listing label as an “Enclosed Industrial Control Panel.” Individual components listed by U.L. and C.U.L. shall not satisfy the above requirement. Manufacturer shall undergo quarterly inspections by U.L. to verify all requirements and standards are met as outlined by U.L. and C.U.L. The controller shall be delivered as an Operating System Three series controller or an approved equal to the specifications to follow.
- .2 Electrical Controllers: Bear a visible U.L. and C.U.L. listing label as proof of subscribership and shall be validated by U.L. www.ul.com/database/ as an “Enclosed Industrial Control Panel”. Certification documents shall accompany bid documents.
 - .1 Manufacturer Name: _____
 - .2 U.L. File Number: _____
 - .
 - .3 Electrical controller and manufacturer shall be recognized and listed by U.L. and C.U.L. Controller shall be manufactured in accordance with Underwriters Laboratories standard U.L.-508A for “Enclosed Industrial Control Panels”. The electrical controller shall include a Class 1 limited energy control circuit. Enclosures shall be N.E.M.A. 12 rated and U.L. listed as Type 12. The electrical control components shall be provided and mounted in an electrical enclosure to restrict access to internal components of the controller by authorized personnel only.

- .3 Controller Performance: Designed to sense the output pressure and/or temperature change inside the ductwork system, which is normally generated by any internal combustion engine designed to propel a motor vehicle. The operating logic shall be designed to complete this cycle. At any point in time when a collection device is connected to a motor vehicle's exhaust tailpipe, as the operator starts the vehicle, the controller shall automatically sense the engine's output pressure or temperature of the exhaust and in turn energize the electrical contactor which will supply power to the A.M.C.A. certified spark resistant fan. Through the use of an adjustable timer the controller shall keep the contactor energized for up to four minutes in accordance with the stations response requirement. If the responding vehicle does not disconnect from the exhaust ventilation system in less than the designated setting, the optional temperature override switch shall override the time delay to ensure continuous system operation. This automated function will work for as long as the exhaust gas temperature is in excess of the setting on the heat sensor located in the ductwork system. This cycle shall not allow the electrical contactor, which energizes the exhaust fan, to short cycle or stop the fan while the system is connected to an operating vehicle.
- .4 Motor Control Contactor: Allen Bradley Industrial Electrical Contactor 100C series. The contactor shall be U.L.-C.U.L. listed as an approved component.
- .5 Motor Control Overload Relay: Allen Bradley 193 E1 Plus series. Overload relay shall have an adjustable trip range to meet the proper full load amperage of the blower motor.
- .6 Soft Touch Controls: Incorporated on the face or the access door of the controller by the use of an adhesive backed Lexan membrane type label to prevent water infiltration, which would void the N.E.M.A. 12 rating. Label: Provided and secured permanently to the exterior of the electrical controller. Label: Includes the name of the manufacturer, address, telephone number, user instructions and any warnings or cautions required by Underwriters Laboratories.
 - .1 Auto Start: This mode of operation shall be strictly for normal day to day use, as it would apply to receiving an emergency call and leaving the station. The system shall maintain itself in the Auto Start mode and always return there after the Stop sequence has been initiated. The controller shall not have a permanent off position due to the potential health hazards of diesel exhaust components.
 - .2 Stop: This mode of operation shall be a system override to shut down the system manually. Upon activating this mode of

operation the exhaust system blower shall shut down. After a period not to exceed three seconds the controller shall automatically return to the Auto Start ready mode. This shall be a safety feature to prevent a potential health hazard from carcinogenic diesel exhaust leakage from systems having an undesirable open nozzle.

- .3 Manual Run: This mode of operation shall be a system override to run the exhaust system blower continuously for the purpose of running the vehicles indoors for equipment checks during inclement weather. Upon activating this mode of operation the exhaust system blower shall start and run continuously until the Stop mode is activated at which point the system will automatically return to the Auto Start ready mode within a maximum three second time period.
- .7 System Indicator L.E.D.'s: Show system status at all times.
 - .1 Auto Start Indicator: Indicate the system is in the fully automatic mode of operation and that power is on to the controller.
 - .2 Fan On Indicator: Indicate that power is being applied to the system blower and the controller is operating normally.
 - .3 Filter Status Indicator: Indicates, if flashing, excessive pressure loss across the optional filter bank media. Consequently the filter must be serviced to maintain optimum efficiency of the system.
 - .4 Stop Indicator: Indicate the fan has been manually de-energized and will return to the Auto Start ready sequence in less than three seconds to prevent the system blower from being left in the Off mode.
 - .5 Manual Run Indicator: Indicate the fan is operating in a continuous run mode until interrupted by the stop mode activation.
- .8 Controller Transformer: UL listed industrial control circuit transformer sized to properly supply all components so that only one transformer shall be required. Transformer shall be provided with multi-tap primary for 115, 208, 240, 277, 400, 480, and 600 V.A.C., and 24 V.A.C. secondary operating on 50 or 60 hertz with a capacity of 35 volt amperes.
- .9 Control Circuit Protection: By the use of primary and secondary fuses to meet U.L. and C.U.L. requirements. The primary shall be protected by a pair of F.L.Q. style fuses. A single G.M.A. style glass fuse rated at

- 3.15 amps at 250 volts shall protect the secondary side of the control circuit.
- .10 Electronic Control Circuit Card: Solid state printed circuit board. The soft touch controls shall be an integral part of the control circuit card. The control circuit card shall utilize a potentiometer to adjust the length of the timing cycle up to 60 minutes. It shall incorporate several different modes of operation and optional features.
- .11 Activation Devices:
- .1 Optional Wireless Transmitter and Receiver System: Shall be an optional feature operating on a 2400 Megahertz frequency. Complies with F.C.C. rule part 15, F.C.C. I.D.: UY124. The receiver shall utilize 3 independent channels of control and capable of supporting up to 60 transmitters. The receiver shall operate on 12-24 V.A.C. or V.D.C. and enclosed in a non-metallic enclosure with a clear see through lid to view system supervisory functions. The transmitter shall be programmable and shall be powered by a 3 year battery for ease of replacement and cost savings. The transmitter shall have an open field range of 1000 feet (305 meters) and shall be initiated by a NO contact closure such as from a pressure switch mounted on the traveling exhaust system trolley or a vehicle powered ignition transmitter mounted in the vehicle.
- .12 Optional No Airflow Alarm: Shall be an optional feature to monitor the system and advise when the exhaust fan is not functioning properly.
- .13 Electrical Wiring: Run in wire channel to allow for easier identification of the wiring circuits and for a neat appearance. All wiring circuitry shall meet National Electric Code and U.L. and C.U.L. standards for proper size, bending radiuses and terminations.
- .14 Electrical Terminal Block: 600 volts, U.L. and C.U.L. rated and recognized. It shall provide individual connection points for remote controls, clean filter indicator and power connections. The primary and secondary control wiring fuses shall be incorporated into the terminal block as one unit.
- .15 Product Manual: Shall be provided with each electrical control box supplied. The product manual shall include a description of components with part numbers inclusive to the controller. It shall include a wiring schematic showing all internal circuitry as well as all field installed wiring connections to the controller.
- .16 Electrical Interference: To protect the apparatus and communications, designs that allow any possibility of electrical back-feed or induced

current which may interfere with a central services communication or onboard vehicle computer logic or navigational equipment will not be accepted.

2.16 Electrical System

- .1 Station Electric Supply Panel: The power circuit for the “Emergency Response Vehicle Exhaust Removal System” shall originate in a circuit breaker panel board of the appropriate size to handle the load. Fan circuit shall be supplied by a U.L. listed, H.A.C.R. rated circuit breaker (H.A.C.R. rating is specifically for motor type loads) of the same type as indicated by the manufacturer of the circuit breaker panel or a dual element time delay fuse for fuse style panels. The circuit shall be clearly marked on an engraved ledger plate or in ink on the panel schedule as “Emergency Response Vehicle Exhaust Removal System”.
- .2 O.S.-3 Automatic Controller: Built and supplied by a U.L. recognized and listed exhaust system manufacturer. Controller shall carry the U.L. –C.U.L. listing label as an “Enclosed Industrial Control Panel”. Individual components listed by U.L. shall not satisfy the above requirement. Manufacturer must undergo quarterly inspections by U.L. to verify all requirements and standards are met as outlined by U.L. and C.U.L. The controller shall be delivered as an Operating System Three series controller or an approved equal to the specifications in 2.16 Electrical Controllers. The controller shall be mounted 6 feet (1.8 meters) to the top of the cabinet A.F.F. (above finished floor). A safety disconnecting means must be within sight of the controller for servicing and for safety reasons. If the supply panel is not within sight, a separate disconnecting means is required beside the controller (per N.E.C. Code 2020). Safety disconnect shall be capable of being locked in the off position to follow lockout, tag out procedures.
- .3 Power Wiring Conduit: Minimum of E.M.T. utilizing fittings for damp locations such as apparatus wash down areas (per N.E.C. Code 2020). Conduit shall be supported with a conduit strap every 10 feet (3 meters) and within 3 feet (1 meter) of each box or termination, (per N.E.C. Code 2020).
- .4 Power Wiring from Supply Panel to O.S.-3: THHN stranded copper wire consisting of a flame retardant, heat-resistant thermoplastic insulation with a nylon jacket for abrasion, gas, and oil resistance and rated up to 600 volts or similar.
- .5 Low Voltage Control Wiring: Minimum of a 16/2 multi-conductor cable to meet U.L. standards for the controller’s low voltage field wiring.

- .6 Low Voltage Control: Encased in a minimum of ½ inch (12.7 millimeters) E.M.T. from the O.S.-3 Controller to the attic or building steel where it shall terminate with a E.M.T. connector with a threaded plastic bushing. Conduit: Supported with a conduit strap every 10 feet (3 meters) and within 3 feet (1 meter) of each box or termination (per N.E.C. Code 2020). The 16/2 multi-conductor cable shall be supported by the building structure and ran in a manner that the cable will not be damaged by normal building use (per N.E.C. Code 2020), securely fastening it with nylon tie wraps every 24 inches (610 millimeters) to 36 inches (914 millimeters). Draping of the cable perpendicular to building steel or support members will be unacceptable.
- .7 Power Wiring from O.S.-3 to Fan Motor: Minimum of E.M.T. utilizing compression type fittings for damp locations such as apparatus wash down areas (per N.E.C. Code 2020). Conduit shall be supported with a conduit strap every 10 feet (3 meters) and within 3 feet (1 meter) of each box or termination (per N.E.C. Code 2020). Conduit shall extend through the outside wall through a hole of the proper size and terminate directly into the back of the safety disconnect with the appropriate connector and sealed with a silicon sealer or cement mortar. (Using fan model number select appropriate wire from Table 1-1).
- .8 Fan Safety Disconnect: Non-fusible, N.E.M.A. 3R rated for wet locations, mounted adjacent to the A.M.C.A. Certified blower. Safety disconnect shall be capable of being locked in the off and on position to follow lockout, tag out procedures (per N.E.C. Code 2020).
- .9 Liquid Tight Flexible Metal Conduit: U.L. listed liquid tight flexible metallic conduit (Sealtite). Conduit will encase the load wires and ground wire from the safety disconnect switch to the blower motor. Conduit length not to exceed 4 feet (1.2 meters) from disconnect to blower motor. The appropriate listed terminal fittings shall be used (per N.E.C. Code 2020).
- .10 Spark Resistant Blower: A.M.C.A. certified, designed and installed as a direct drive spark resistant blower. The motor shall meet current E.P.A.C.T. standards for energy savings. Fans utilizing belt drives and steel impellers will not be accepted.
- .11 Optional Temperature Switch: One for each apparatus connected to the system. The temperature switch shall be of the snap disc type and adjustable from 90 degrees Fahrenheit (32 degrees Celsius) to 130 degrees Fahrenheit (54 degrees Celsius). It shall be mounted on the ductwork or on the trolley by drilling a 1 inch (25 millimeters) hole, sealing the switch with silicone sealant and securing with 2 self drilling

screws. Can be used in conjunction with the optional wireless control system.

Electrical connection shall be made with terminals provided or solder less type such as Thomas and Betts part no. 14RB-2577 or equivalent.

- .12 Pressure Switch: One for each apparatus connected to the system. The pressure switch shall operate at a maximum of 24 V.A.C., pre-calibrated at .18 inch of water column. Mounting shall be accomplished by drilling a $\frac{3}{8}$ inch (9.5 millimeters) hole into the aluminum rail profile and thread the hole with a $\frac{1}{8}$ inch N.P.T. tap, then thread the switch into the rail. For wireless systems, mounting shall be accomplished by drilling a $\frac{3}{8}$ inch (9.5 millimeters) into the hose connection of the trolley and threading the switch into the hole. The electrical connections shall be made with a 0.020 inch (.5 millimeters) by 0.187 inch (4.8 millimeters) female quick disconnect terminals, such as Thomas and Betts part no. 14RBD-18277 or equivalent.

2.17 Air Moving Devices

- .1 Centrifugal Fans: Direct drive centrifugal type, high pressure, single width, single inlet as required or indicated. Impeller Wheels: Radial design or backward incline for performance, spark resistant and made of a non-ferrous material to prevent static electricity build up. The impeller shall be dynamically and statically balanced and of the non-overloading type to provide maximum efficiency while achieving quiet, vibration-free operation. The fan housing shall be manufactured from an epoxy powder coated galvanized steel or nonferrous material. The outlet configuration shall be top horizontal or up blast. (Installer needs to verify when submittals are sent. The housing shall be capable of field reconfiguration in the event the mounting position needs to be changed for unforeseen reasons. The exhaust discharge outlet shall be in compliance with International Mechanical Code and A.C.G.I.H. recommendations (min. of 36 inches (1 meter) above roofline). Air intakes, windows, cascade systems, prevailing currents, communication equipment and building aesthetics shall be considered in the final location of the fan.

For aesthetic reasons the fan motor and assembly shall be mounted on an epoxy powder coated galvanized steel mounting base to prevent rust stains on the exterior of the building. Belt driven fans are unacceptable due to maintenance reasons and the potential for the fan to be left non-operational without warning.

- .2 Fan Motor and Bearing: All $\frac{1}{2}$ horsepower (373 watts) to 15 horsepower (11 kilowatt) motors shall be totally enclosed fan cooled

(T.E.F.C.) continuous duty rated. The motors shall be dual voltage where applicable. Motors shall comply with the government mandated "Energy Policy and Conservation Act" (E.P.A.C.T.) as outlined by the Department of Energy. The bearings shall be self-aligned, ball bearing type permanently sealed and lubricated.

- .3 Performance: Lengths of ductwork, hoses, elbows, branches, wyes, etc. which increase the static pressure of the system, shall be taken into account to properly size the fan. The delivered volume shall be calculated taking into account the static regain of the vehicles engine exhaust (based on a virtually airtight connection at the tailpipe). The manufacturer's provided fan(s) shall be performance guaranteed by A.M.C.A. certification.
 - .1 Required Fan Capacity: The Fan Capacity shall be sized as such as to deliver the required C.F.M. at each hose drop to which the vehicle is attached.
 - .1 The 4 inch (100 millimeters) hose system shall be designed to deliver a minimum of 340 C.F.M. (577 square meters per hour) at a velocity of 4500 F.P.M. (23 meters per second) at the hose and nozzle connection.
- .4 Location: The preferable fan location shall be on the outside of the fire station as far away from any living quarters as possible so that firefighters would not be disturbed by the system activation. No blower fans shall be mounted inside the fire station. Silencers shall be provided when fan sound pressure level exceeds 64 decibals.

2.18 Ductwork System

- .1 Ductwork Type and Materials: U.M.C. Class 2 or S.M.A.C.N.A. Class II product conveying duct, meet or exceed criteria for construction and performance as outlined in Round Industrial Duct Construction Standards, S.M.A.C.N.A.. Materials of construction unless otherwise specified for all ductwork and fittings shall be a minimum G-90 galvanized sheet metal (A.S.T.M. A653/A653M). Only when specified, Type 304 stainless steel (A.S.T.M. A240/A240M) shall be provided.
- .2 Ductwork Sizing and Gauges: Round pipe construction, with the range of available sizes not to exceed 16 inches (406 millimeters) in diameter. Duct gauge shall depend on diameter and a minimum operating pressure of 8 inches of water gauge (1993 pascals). Acceptable Gauge and Reinforcement Requirements: Inner duct diameter 4 inches (101 millimeters) through 11 inches (279 millimeters) diameter shall be 22 gauge standard pipe (International Mechanical Code).

- .3 Ductwork Fittings: Round and have a wall thickness 2 gauges (one even gauge number) heavier than the lightest allowable gauge of the downstream section of duct to which they are connected (International Mechanical Code). Air Duct Branch Entrances: Factory fabricated fittings or factory fabricated duct /tap assemblies. Fittings: Constructed so that air streams converge at angles no greater than 45 degree (International Mechanical Code). All Seams: Continuous stitch welded and if necessary internally sealed to ensure air tightness. Turning elbows shall be stitch-welded and used for all diameters and pressures. They shall be fabricated of 24 gauge galvanized steel and constructed as two piece with continuous welded seam construction fittings similar to those provided by Lindab Incorporated. Tapered Body Fittings: Used wherever particular fallout is anticipated and where air flow is introduced to the transport duct manifold.
 - .4 Ductwork Design Velocities: Minimum of 3500 F.P.M. (18 meters per second) to 4000 FPM (20 meters per second) transport velocity. Capture Velocity: 4500 F.P.M. (23 meters per second) to 5500 F.P.M. (28 meters per second) to extract virtually 100 percent of the exhaust gases.
 - .5 External Ductwork: Sized for the exact inlet and outlet of the exhaust fan blower. An exhaust rain cap shall be supplied and manufactured in accordance with E.P.A. standard for free draft rain cap requirements. Included as an integral part of this rain cap shall be a back draft damper to provide protection from rain and other inclement weather.
 - .6 Exhaust Penetrations: The core drilling shall be properly sized to reduce the diameter of the opening to the smallest possible size.
- 3 Execution
- 3.1 Examination
 - .1 Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, service-utility connections, and other conditions affecting installation and performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.
 - 3.2 Preparation
 - .1 Provide surface/substrate preparation as required by the manufacturer's printed installation instructions. Do not proceed with installation is in proper condition to receive vehicle exhaust system installation.
 - 3.3 Installation

- .1 Install vehicle exhaust system in accord with manufacturer's written instructions, original design and referenced standards.

3.4 Adjusting

- .1 Adjust vehicle exhaust system for proper operation. Replace any parts that prevent the system from operating properly.

3.5 Cleaning

- .1 Remove all debris caused by installation of the vehicle exhaust system. Clean all exposed surfaces to as fabricated condition and appearance.

3.6 Protection

- .1 Provide protection of the completed installation until completion of the project. Repair any damage at no additional cost to Owner.

3.7 Training

- .1 Provide training to fire department personnel in the daily use and maintenance of the vehicle exhaust removal system that has been installed and specified herein. The fire department shall be notified at least 7 days prior to the date scheduled for the training course. Training shall be for all personnel involved with the operation of the exhaust removal system to include all shifts required to man the particular facility. The Training session shall be performed in person by a recognized representative of the manufacturer of the exhaust removal system, in addition a training video shall be provided to the fire department.
- .2 Provide training to all shifts during their normal shift period.

3.8 Warranty

- .1 Provide a written warranty for a period of one (1) year from date of shipment for all components.

End of Section

1 General

1.1 Requirements

- .1 Air outlets shall meet the following standards and requirements:
 - .1 A.S.H.R.A.E.
 - .2 A.M.C.A.
 - .3 Local Codes and Requirements
- .2 Air flow tests and sound levels shall be made in accordance with A.S.H.R.A.E. standards.
- .3 Manufacturers shall certify performance and application.

1.2 Submittals

- .1 Shop Drawings:
 - .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
 - .2 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards. Louver shop drawings shall include free area, pressure drop and water carry over data.
 - .3 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.
- .2 Operation and Maintenance Data:
 - .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
 - .2 Operation and maintenance data shall be included in the maintenance manual.

2 Products

2.1 General

- .1 Air flow tests and sound levels shall be made in accordance with A.S.H.R.A.E. standards.
- .2 Manufacturers shall certify performance and application.
- .3 All supply grilles shall be adjustable with double deflection.

2.2 Grilles and Diffusers

- .1 Provide grilles, registers and diffusers of the types as shown on the drawings.
- .2 Provide vertical throw type as noted based on ceiling heights.
- .3 Construction shall be heavy duty, with 14 gauge steel blades and heavy duty steel support bars and frame unless otherwise noted.
- .4 Grilles shall be complete with steel volume damper of the opposed blade type for balancing purposes as noted.
- .5 Supply diffusers mounted in t-bar shall not contain integral balance dampers. Balance dampers must be installed in branch duct runs to diffusers.
- .6 Acceptable Manufacturers:
 - .1 Price
 - .2 Nailor
 - .3 Titus
 - .4 Metal Aire
 - .5 Kreuger

2.3 Louvers

- .1 Louvers shall be licensed to bear the A.M.C.A. seal and certified by the manufacturer for outdoor use.
- .2 Louvers shall be sized as noted on drawings and model selected to prevent moisture carry-over (intake louvers at 885 f.p.m. for base specified E.H. Price DE635).
- .3 Frame shall be 0.081 inches (2.06 millimeters) extruded aluminium, alloy 6063-T5.
- .4 Blades shall be 0.081 inches (2.06 millimeters) extruded aluminium, alloy 6063-T5, at an angle of 35 degree on 3.5 inches (89 millimeters) centres. Louver assembly shall have blades contained within a single frame.
- .5 Louver components including heads, jambs, sills and mullions shall be factory assembled.
- .6 All materials shall be factory finished after assembly with Powder Coat, unless otherwise indicated.
- .7 Louvers shall be complete with 19 gauge galvanized birdscreen with ½ inches by ½ inches openings.

- .8 Submit all performance data with shop drawings for free area, pressure drop and water carry over.
- .9 Acceptable Manufacturers:
 - .1 Ventex
 - .2 Tamco
 - .3 Price
 - .4 Ruskin
 - .5 Greenheck
- 2.4 Door Louvers
 - .1 Louvers shall be equipped with integral fire damper.
- 3 Execution
 - 3.1 Grilles and Diffusers
 - .1 Confirm location, type of mounting and size of all outlets with site conditions prior to ordering and installing.
 - .2 Provide flanged connection off ductwork for mounting of grilles.
 - .3 **Paint inside of ductwork flat black behind supply and return wall grilles.**
 - .4 Position vertical throw diffusers and deflection of grilles to achieve best air flow in area. Adjust to suit Balancing Contractor and Engineer's requirements.
 - .5 Provide birdscreen on all open ended return air ducts unless otherwise noted.
 - 3.2 Louvers
 - .1 Confirm location and size of all louvers with General Contractor prior to ordering and installing.
 - .2 Provide 16 gauge galvanized sheet metal sleeve through wall opening where required.
 - .3 All louvers shall be equipped with birdscreen.
 - .5 Provide caulking at all louvers using non-shrink Mono caulking to match building colour.
 - 3.3 Door Louvers
 - .1 Door supplier shall supply and install door louvers.

End of Section

Part 1 General

1.1 General

- .1 Conform to the General Provisions For Mechanical Section 23 72 13 and Basic Materials and Methods Section 23 05 01.

1.2 Submittals

- .1 Submit shop drawings and product data in accordance with Section 23 05 02.
- .2 Indicate the following: complete specifications; wiring diagrams (showing all interconnections); weight; performance details.
- .3 Provide data for inclusion in the Operating and Maintenance manuals in accordance with Section 23 05 02.

Part 2 PRODUCTS

2.1 General

- .1 Provide units listed by Underwriters Laboratories Canada c.U.L. 1812. Unit shall be A.R.I. certified in accordance with the A.R.I. *Air-to Air Energy Recovery Ventilation Equipment Certification Program*. Unit shall bear the AMCA certified ratings seal for air performance.
- .2 Provide each unit factory assembled, wired, tested and shipped in one piece. Installation and maintenance bulletins and wiring manuals shall be supplied with each unit.
- .3 The following manufacturers are approved in principle subject to meeting the specifications. Manufacturers are responsible for all co-ordination issues arising from dimensional variances between plans and site conditions.

2.2 Cook, Greenheck, York, Ruskin

2.3 Cabinet

- .1 Fabricate unit with 18 gauge galvanized steel panels, bolted to a 16 gauge galvanized steel base with integral lifting lugs. All mechanical fasteners shall be Corrosion resistant. All panels and access doors shall be sealed with a thermal gasket.
- .2 Panels and access doors shall be constructed as 1-inch thick, thermal broke wall assemblies with three pound density foil faced insulation.

Insulation shall be fastened to the panels with weatherproof adhesive and weld pins.

- .3 Insulation shall be manufactured and tested to meet N.F.P.A. 90A and U.L. 181 requirements.
- .4 Access doors shall be flush mounted to the cabinetry and secured with heavy-duty hinges. The door latch handle assembly shall be provided with a full-size grip handle. The assembly shall be gasketed and sealed to prevent thermal bridging.
- .5 Outdoor units shall have a solid metal roof cap, intake hoods, exhaust hoods and piping vestibules.
- .6 Units shall be finish painted with an electrostatically applied, baked polyester powder coating. Color shall be gray

2.4 Energy Recovery Wheel

- .1 The enthalpy wheel shall be constructed of fluted synthetic fibrous media, impregnated with a non-migrating water selective 4 angstrom molecular sieve desiccant. Wheel media shall be 4 inch thick. Energy transfer ratings shall be A.R.I. certified in accordance with the A.R.I. *Air-to Air Energy Recovery Ventilation Equipment Certification Program*, based on A.R.I. Standard 1060-2000.
- .2 Provide the unit with a factory set purge sector designed to limit cross contamination.
- .3 Energy recovery wheel shall be mounted on a slide track for easy inspection and cleaning.

2.5 Fans

- .1 Wheels shall be belt D.W.D.I. centrifugal forward curved type.
- .2 Fan assemblies including fan, motor and sheaves shall be dynamically balanced by the manufacturer in accordance with A.M.C.A. Standard 204-05, *Balance Quality and Vibration Levels for Fans*.
- .3 Bearings and Drives
- .4 Provide self-aligning ball or roller bearings, permanently lubricated (greasable bearings with extended copper lubrication lines). Load rating

shall be computed in accordance with A.F.B.M.A. – A.N.S.I. Standards, L-50 life at 200,000 hours heavy duty pillow block type.

- .5 Provide solid, hot rolled steel, ground and polished shaft, protectively coated with lubricating oil.
- .6 Provide variable pitch sheaves on all motors 7 1/2 horsepower and lower. Provide constant pitch sheaves on all motors greater than 7 1/2 horsepower sizes V-belt drive for a service factor of 1.25. On constant

pitch units, allow for one sheave change including belts (parts only, labour by balancing contractor).

- .7 Locate fan and motor internally on a steel base. Provide access to motor, drive and bearings through hinged access door. Provide fan and motor assembly mounted on rubber vibration isolators inside cabinet.
- .8 Motors shall be high efficiency 1800 R.P.M., open drip-proof - type with greaseable ball bearings.

2.6 Filters

- .1 Provide filter box section with filter guides, hinged and latching access doors for side loading of filters. Filter media shall be U.L. 900 listed, Class I or Class II.
- .2 Provide Flat arrangement with 2 inch deep pleated panel filter.

2.7 Controls

- .1 To be configured.

2.8 Formed Steel Dampers

- .1 Formed steel dampers and frames shall be made from 16 gauge galvanized steel.
- .2 Drive shaft clamp plates shall be made with 12 gauge galvanized steel and set screws.
- .3 Blade seals shall be PVC suitable for minus 40 degrees Fahrenheit air temperatures.
- .4 Jamb seals shall be stainless steel.
- .5 Provide jack shaft assemblies for multiple damper installations.

2.9 Damper Operators

- .1 Provide factory installed electric damper operators with all linkage and hardware internally mounted.
- .2 Ensure operators are mounted in easily accessible sections of the air handling unit.
- .3 Acceptable manufacturers are Johnson Controls and Belimo.

2.10 Hoods

- .1 Outdoor units shall be supplied with fresh air and exhaust air hoods complete with ½ inch by ½ inch bird screen, finished to match the unit. A

rain gutter shall be provided on all edges of the hood. Outside air hoods shall be sized for maximum inlet velocity of 600 F.P.M..

2.11 Roof Curbs

- .1 Roof curbs shall be manufactured from 12 gauge galvanized steel.
- .2 A 2 by 4 nailing strip shall be provided around the entire perimeter.

2.12 Electrical

- .1 Each unit shall be wired and tested at the factory before shipment. Wiring shall comply with all applicable U.L. and C.S.A. standards. All wiring shall be number coded per the electrical wiring diagrams. All electrical components shall be labeled according to the electrical diagram and be C.S.A. recognized where applicable.
- .2 All internal electrical components shall be pre-wired for single point power connection. Internal control panel shall be U.L. listed with hinged access door and disconnect switch.
- .3 Each motor shall have a motor starter combination providing fuseless disconnect, over-current, overload and motor starting functions.

2.13 Start-up

- .1 The manufacturer shall provide a factory trained service technician to start-up each unit. Manufacturer shall provide instruction to the owners' personnel on proper unit operation and maintenance. The warranty period shall commence on the date of initial start-up and shall continue for a period of one (1) year not to exceed eighteen (18) months from date of shipment.

Part 3 Execution

3.1 Installation

- .1 Install units on a flat surface level within 1/8 inch. Provide intermediate supports as recommended by the equipment manufacturer.
- .2 For ceiling hung installations, provide a reinforced steel framework to adequately support all unit sections.
- .3 Provide certified wiring schematics to the electrical division for associated equipment and controls.
- .4 Provide all necessary control wiring as recommended by the manufacturer.

End of Section

Part 1 - General

1.1 Scope

- .1 This section covers the supply and installation of ductless mini-split systems as shown and/or specified. In general, the portions of the work are:
 - .1 Indoor mini-split unit
 - .2 Outdoor Condensing Unit

1.2 System Description

- .1 The air conditioning system shall be a split system series with outdoor unit.
- .2 The system shall consist of a wall mounted evaporator that with wired control and outdoor unit.

1.3 Quality Assurance

- .1 The units shall be listed by Electrical Laboratories (E.T.L.) and bear the E.T.L. label.
- .2 All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- .3 The units shall be manufactured in a facility registered to I.S.O. 9001 and I.S.O.14001 which is a set of standards applying to environmental protection set by the International Standard organization (I.S.O.).
- .4 A factory charge of R-410A refrigerant shall be provided in the condensing unit.
- .5 A dry air holding charge shall be provided in the evaporator.
- .6 System efficiency shall meet or exceed 14.3 S.E.E.R.
- .7 Outdoor units shall withstand 1,000 hours of salt spray tested per procedure A.S.T.M. B117.
- .8 R.o.H.S. Compliant.

1.4 Delivery, Storage and Handling

- .1 Unit shall be stored and handled according to the manufacturer's recommendation.
- .2 The wired controller shall be shipped inside the carton with the indoor unit and able to withstand 105 degrees Fahrenheit storage temperatures and 95 percent humidity.

1.5 Acceptable Manufacturers:

- .1 Daikin
- .2 Mitsubishi

.3 Samsung

.4 Carrier

1.6 Warranty

.1 The units shall have a complete system warranty of:

.1 Two (2) years Parts.

.2 Six (6) years Compressor.

1.7 Performance

.1 Each system shall perform in accordance to the ratings shown in the schedule on the drawings.

.2 Performance shall be based on 67 degrees F.W.B., 80 degrees FDB for the indoor unit and 95 degrees F.D.B., 75 degrees F.W.B. for the outdoor unit.

Part 2 - Products

2.1 Air Conditioning System

.1 The variable capacity air conditioning system shall be a Daikin Variable Refrigerant Volume Series (heat/cool) heat pump system as specified. The system shall consist of multiple evaporators, REFNET™ joints and headers, a two pipe refrigeration distribution system using PID control, and Daikin V.R.V.® condensing unit. The condensing unit is a direct expansion (D.X.), multi-zone air-conditioning system with variable speed inverter driven compressors using R-410A refrigerant. Outdoor air cooled condensing units may have a total connected indoor evaporator capacity of up to 130 percent of the rated outdoor condensing unit capacity.

.2 Condensing unit shall be interconnected to indoor unit models that range in capacity from 7,500 B.t.u. per hour to 96,000 B.t.u. per hour. Each indoor unit or group of indoor units shall be independently controlled.

.3 Operation of the system shall be set to either heating or cooling.

2.2 Refrigeration Piping

.1 Y. style piping joints and headers provided by the manufacturer shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance. T. style joints and/or joints provided by the installing contractor shall not be acceptable.

2.3 Wall Mounted Unit

.1 Unit shall feature a compact design with a finished white casing.

.2 A mildew-proof, polystyrene air filter and condensate drain pan shall be included as standard equipment.

- .3 Cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation. Unit sound pressure shall range from 32 d.B.(A) to 35 d.B.(A) at low speed measured at 3.3 feet below the unit.
- .4 The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops. The remote controller shall be able to set five (5) steps of discharge angle. The front grille shall be easily removed for washing.
- .5 Unit shall be provided with a return air thermistor.
- .6 The fan shall be a direct-drive fan, with a statically and dynamically balanced impeller, with high and low fan speeds settings.
- .7 Units shall be provided with a condensate pump. Contractor shall provide a pump where not integral to unit.
- .8 Units shall be suitable for space sensors by B.A.S. Contractor.

2.4 Condensing Unit

- .1 The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish. The unit shall be modular in design and shall allow for side-by-side installation with minimum spacing requirements.
- .2 Units shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of Daikin scroll compressors, motors and fans (with air cooled units), condenser, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator.
- .3 The system shall automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
- .4 The unit shall incorporate an auto-charging feature and a refrigerant charge check function.
- .5 To ensure the liquid refrigerant does not flash when supplying to the various fan coil units, the circuit shall be provided with a sub-cooling feature.
- .6 The Daikin inverter scroll compressors (semi-hermetic) shall be variable speed (P.A.M. inverter) controlled which are capable of changing speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity shall be controlled to eliminate deviation from target value.
- .7 Neodymium magnets shall be adopted in the rotor construction to yield a higher

torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.

- .8 The following safety devices shall be included in the condensing unit; high pressure switch, control circuit fuses, crankcase heaters, fusible plug, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressors and motors, over current protection for the inverter and anti-recycling timers.
- .9 Oil separators shall be standard with the equipment together with an intelligent oil management system. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation.
- .10 The outdoor unit shall be capable of heating operation at minus 4 degrees Fahrenheit dry bulb ambient temperature without additional low ambient controls. The system shall continue to provide heat to the indoor units in heating operation while in the defrost mode.
- .11 The fan motor shall have inherent protection and permanently lubricated bearings. The motor shall be provided with a fan guard to prevent contact with moving parts. The condensing unit shall consist of one or more propeller type, direct-drive 350 and 750 Watt fan motors that have multiple speed operation via a DC (digitally commutating) inverter. Motors shall be capable of delivering design air at high external static pressures up to 0.32 inch W.G. (factory set as standard at 0.12 inch W.G.) to accommodate field applied duct for indoor mounting of condensing units.
- .12 Night setback control of the fan motor for low noise operation by way of automatically limiting the maximum speed shall be a standard feature.
- .13 The heat exchanger on the condensing units shall be manufactured from Hi-X. seamless copper tube with N.-shape internal grooves mechanically bonded onto aluminum fins to an e-Pass Design. The fins are to be covered with an anti-corrosion acrylic resin and hydrophilic film type E.1.
- .14 Unit shall have low ambient kit.

2.5 Controls

- .1 Fan coil units shall be supplied with Individual Zone Controllers, similar to Daikin model BRC1E71.
- .2 Remote controllers shall be hard wired by installing contractor.
- .3 Provide control board for space sensors by B.A.S. and B.A.S. enable/disable.
- .4 Controllers shall be able to function as follows:
 1. The controller shall have a maximum wiring length of 1,640 feet.

2. The controller shall have a self diagnosis function that constantly monitors the system for malfunctions (total of 80 components).
3. The controller shall be able to immediately display fault location and condition.
4. An L.C.D. digital display will allow the temperature to be set in 1 degree Fahrenheit units.
5. The controller shall be equipped with a thermostat sensor in the remote controller making possible more comfortable room temperature control.
6. The controller shall monitor room temperature and preset temperature by microcomputer and can select cool/heat operation model.
7. The controller shall have a 48 hour clock/calendar backup.
8. Controller shall have built-in schedule timer

2.6 Electrical

- .1 The power supply to the condensing unit shall be as scheduled.
- .2 The control voltage between the indoor and outdoor unit shall be 16 V.D.C. non-shielded 2 conductor cable.
- .3 The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one outdoor unit with one 2-cable wire, thus simplifying the wiring operation.
- .4 Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit then to the branch selector box and outdoor unit. Control wiring shall run from the indoor unit terminal block to the specific controller for that unit.

2.7 Start-Up

- .1 The system must be installed by a Daikin factory trained contractor/dealer. The mechanical contractor's installation price shall be based on the systems installation requirements. The mechanical contractor bids with complete knowledge of the H.V.A.C. system requirements.
- .2 The manufacturer shall provide a factory trained service technician to start-up each unit. Manufacturer shall provide instruction to the owners' personnel on proper unit operation and maintenance.

Part 3 - Execution

3.1 Indoor Unit

- .1 Install unit as per manufacturer's recommendations.
- .2 Allow easy access to change filters and maintain unit.

- .3 Provide a drain line from unit and tie into main drain line. Provide a condensate pump to allow drain line to be concealed within ceiling space.

3.2 Condensing Unit

- .1 Mount outdoor on roof on level double height concrete patio stones with rigid insulation board under patio stones.
- .2 Patio stones shall be installed level and shall extend minimum 100 millimeters (4 inches) outside perimeter of condensing unit.
- .3 Maintain clearance around unit as per manufacturer's recommendations to allow proper access and service.

3.3 Controls

- .1 Mount thermostat/sensor on wall so as not to be obstructed by room contents.
- .2 Provide control wiring in conduit or flexible cable recessed in wall and in ceiling space. All outdoor control wiring shall be run in liquidtight.
- .3 Refer to Section 23 09 23.

3.4 Demonstration

- .1 Participate in Demonstration to the Owner with the Consultant and third party commissioning Agent.

End of Section

Part 2 - Products

1.1 General

1.1.1 Units shall be Daikin or other approved manufacturer. Units shall be A.R.I. certified and C.S.A. approved. Units shall provide capacities detailed in schedule at the ampacity and voltage detailed in the schedule. All units shall have C.O.P.s to meet the requirements of A.S.H.R.A.E. 90.1.

1.1.2 Minimum heat pump efficiencies shall be as listed on the equipment schedules. Equipment which does not meet or exceed the scheduled performance figures will not be considered equal.

1.2 Sound

1.2.1 Heat pump units shall meet the sound power levels indicated in the equipment schedule. Sound power data is in accordance with A.H.R.I. 260 and must be provided in 8 octave band format, at full load.

1.2.2 Unless authorized written exception is granted by the owner or the consultant, suppliers who cannot meet the sound levels scheduled shall supply and install sound attenuating devices as required to meet the specified performance.

1.3 Cabinet

1.3.1 The cabinet shall be fabricated from heavy gauge G-60 galvanized sheet metal, finished with powder coat paint. Unpainted units will not be accepted. Interior surfaces shall be lined with 1/2 inch thick, 1-1/2 pounds foil faced insulation in the compressor section and 1/2 inch thick, 1-1/2 pounds coated glass fiber insulation in the fan section. The insulation shall have a flame spread of less than 25 and a smoke developed classification of less than 50 per A.S.T.M. E-84 and U.L. 723. All insulation must meet N.F.P.A. 90A requirements.

1.3.2 All units shall have a factory-installed 1 inch duct flange on the discharge of the blower and must have a minimum of two access panels to provide access to the compressor compartment and one access to the blower

- compartment. Unit shall have an insulated panel separating the blower compartment from the compressor compartment.
- 1.3.2.1 All access panels shall be lined with gaskets to provide an airtight seal and improved sound attenuation.
- 1.3.3 All piping connections shall protrude through the cabinet for connection to flexible hoses.
- 1.3.4 Drain pans shall be manufactured from stainless steel and shall meet A.S.H.R.A.E. standard 62.1-2007 section 5.11. Drain pan shall be sloped. Mastic coated, galvanized or plastic drain pans will not be accepted.
- 1.4 Refrigeration Circuit
- 1.4.1 Two Stage Units:
- 1.4.1.1 Provide units with two stage compressors as noted on the schedules.
- 1.4.1.2 Single stage premium efficiency units shall be manufactured with Copeland hermetic scroll compressors. Two stage units shall be supplied with Copeland Ultra-Tech compressors which provide 67 percent part load operation.
- 1.4.2 All units shall have double isolation plates in the compressor section for added mass and improved noise attenuation. Two sets of neoprene isolators shall be provided to separate the bottom mass plate from the unit casing, and between the compressor. Provide high density insulation between the mass plate and the unit casing. Equipment without the double mass plates will not be accepted.
- 1.4.3 Units shall have a sealed refrigerant circuit which includes a non-C.F.C. depleting R.410A refrigerant. Refrigeration circuit shall include a compressor; reversing valve; aluminum fin and rifled copper tube refrigerant-to-air heat exchanger; thermostatic expansion device; and airside coil. The coaxial coils shall be rated for 600 p.s.i.g. on the refrigerant side and 500 psig on the water side. Heat exchanger shall be manufactured from copper [cupronickel].
- 1.4.4 Refrigeration safeties and specialties shall include high and low pressure switches, internal compressor overload protection, low refrigerant suction temperature switch for freeze protection, and high/low side refrigerant service ports for gauge connection.
- 1.4.5 A waterside economizer coil shall be factory installed within the unit casing. The coil shall be constructed of aluminum fins mechanically bonded to copper tubes. Factory installed controls shall consist of a 3-way modulating valve controlled by the unit microprocessor and an adjustable aquastat.

- The economizer piping shall be factory connected to the condensers for a single field supply and return connection.
- 1.4.5.1 If the water conditions are adequate, the control sequence shall allow simultaneous waterside free cooling and mechanical cooling.
- 1.4.6 Two-way motorized isolation valves shall be factory installed inside the compressor compartment. The valve actuator shall be factory wired to the Microtech III controller.
- 1.4.7 Water source heat pump units shall be designed to operate in geothermal applications. Units shall be able to start in both heating and cooling modes with 40 degrees Fahrenheit entering solution temperature.
- 1.5 Fan
- 1.5.1 All fans shall be manufactured with Smart Airflow Control E.C.M. motors. Motors shall be equipped with an easily adjusted selector switch for field changes to the airflow. A minimum of 4 settings shall be offered. Suppliers of E.C.M. motors with dip switches or which require computer software to aid in the adjustment of the fan speed, shall provide the services of a trained technician to assist in the balancing and commissioning of each heat pump.
- 1.5.2 Unit controller shall automatically adjust the fan speeds based on the mode of unit operation. Refer to controls section for further details on dehumidification and cooling stage modes.
- 1.5.3 Four legged fan mounts shall be used for added stability and vibration control.
- 1.6 Filters
- 1.6.1 Provide flat arrangement filter boxes designed for 2 inch deep pleated panel filter. Filter boxes shall be gasketed with a leakage rate of less than 4 c.f.m per square foot at 0.5 inches static in order to meet L.E.E.D. N.C. E.Q. Credit 5.
- 1.6.2 Filter efficiency shall be Merv 8.
- 1.6.3 Filter sections shall be gasketed to provide leakage rates less than 4 c.f.m. per square foot at 0.5" static pressure, in order to meet L.E.E.D.-N.C. E.Q. credit 5.
- 1.7 Controls
- 1.7.1 Unit controls shall be equivalent to the McQuay MicroTech III microprocessor control board. Operating and safety controls shall include: low suction temperature (freezestat) switch; high refrigerant pressure switch; low refrigerant temperature sensor; compressor overload protection; and supply fan overload protection. Reset of automatic lockouts shall be by

interrupting the power supply to the unit, or by the remote reset feature. An intelligent reset controller shall minimize nuisance trips by automatically clearing the first two faults in a 24 hour period. An automatic lockout will only occur on the third fault. The reset counter shall be reset to zero every 24 hours. In addition to the features provided by the microprocessor, the control box shall contain the following components: controls for compressor,

reversing valve, and fan motor; control transformer, and a terminal block for low voltage field wiring connections.

1.7.2 Unit control logic shall provide heating and cooling operation as required by the thermostat. Control system shall provide the following:

- fan speed increase based on stage of cooling
- dehumidification mode
- time delay compressor operation
- low pressure switch bypass
- unit reset at the thermostat
- delayed de-energization of the reversing valve
- short cycle protection and random unit start
- high refrigerant pressure alarm
- low suction pressure alarm
- condensate overflow alarm
- brownout alarm
- service diagnosis via 6 external L.E.D.'s

The microprocessor shall include the following functions based on remote signals:

- load shed
- emergency shutdown
- night setback and override
- pump restart on night setback

1.8 Optional: Thermostat Control by Others

1.8.1 The unit shall be supplied with terminal blocks or connection to B.A.S. system by others.

1.9 Hoses and Ball Valves

1.9.1 All units shall be supplied with hose kits. Condensate hose shall be 24 inches long. Supply and return hoses shall be 24 inches long with N.P.T. at both ends and a swivel at one end. Hoses shall have braided stainless steel outer covering. Complete hose kit shall be flame retardant.

Components shall meet the requirements of A.S.T.M. E84-81a, N.F.P.A. 225 and U.L. 723.

- 1.9.2 The unit shall be supplied with two field mounted combination balancing and shutoff ball valves with adjustable memory stops.

Part 3 – Execution

3.1 Installation

- .1 Install horizontal heat pumps using hanger kit and rubber isolators provided by heat pump supplier.
- .2 Install vertical heat pumps on neoprene vibration isolation pads.
- .3 Install all units neat and level following manufacturers instructions.
- .4 Install flexible pipe ball valves and duct connections between heat pump units and piping/ductwork.
- .5 System cleaning and flushing shall be completed as described in the "General instruction for Mechanical Sections".
- .6 All control wiring, conduit, accessories, etcetera, shall be installed in accordance with the requirements specified by Division 16 and the local electrical authority.
- .7 All electrical interlock and control wiring between closed circuit cooler, circulation pumps, etcetera, and loop water controller shall be the responsibility of this section as part of the Loop Water Control System.
- .8 All power wiring from motor control centers and/or motor starter panels to driven motor of equipment shall be by Division 16.
- .9 Co-ordinate with Electrical Division all power wiring to heat pumps, loop water controller and accessories.
- .10 Furnish the services of a trained representative of the equipment manufacturer to supervise the installation, wiring, set up and testing of the loop water controller. Upon completion of the installation, the manufacturer shall instruct a representative of the owner on the proper operation of the loop water control system.

End of Section

Part 1 - General

1.1 Quality Assurance

- .1 Unit heaters shall be products of manufacturer regularly engaged in production of such units who issues complete catalogue data on such products.
- .2 Fans rated in accordance with A.M.C.A.
- .3 One year warranty.

1.2 Submittals

- .1 Submit certified performance data, water flow, pressure drop, suspension method, weight, fan power, fan performance, electrical characteristics.

1.3 Acceptable Manufacturers

- .1 Sigma
- .2 Engineered Air
- .3 Trane

Part 2 - Products

2.1 Unit Heaters

- .1 Furnish and install Sigma U.H.H.L. horizontal unit heaters per models and sizes as shown on plans and schedules and as described in specifications.
- .2 Cabinet: Cabinets shall be constructed from heavy-duty cold -rolled corrosion-resistant steel finished in grey baked enamel. Fronts shall have integral double folded discharge frame for additional cabinet rigidity. Back panels shall have integral inlet collars for superior stiffness. Suspension tapings shall be securely fastened to top panel. Units to comply with A.M.C.A. type C. construction. Finish: Sheet metal chemically degreased, phosphatized and etched. Semi-gloss "grey" paint finish.
- .3 Coils: Coils to be minimum 3 rows deep. Coils shall be constructed from heavy-wall ½ inch outside diameter copper tube with mechanically bonded aluminum fins. Coils shall be pressure tested at 450 p.s.i.g. and rated at no less than 600 p.s.i.g. design working pressure
- .4 Fans: Fans shall be designed and selected for high efficiency. Fans shall be statically and dynamically balanced for quiet, low vibration operation. Fan blades are aluminum for corrosion resistance.
- .5 Motors: Motors shall have permanently lubricated ball bearings with minimum average life of 100,000 hours. Motors shall be of totally-enclosed construction as T.E.A.O., T.E.N.V. or T.E.F.C.. T.E.A.O. motors shall be

resiliently mounted. Single-phase motors operating at 250 Volts or less shall have built-in automatic thermal overloads.

- .6 Motor Mounts: Rugged, corrosion resistant, resiliently mounted.
- .7 Air Outlet: Louvre fin diffusers shall have individually adjustable blades for maximum air distribution flexibility.
- .8 Controls: Provide required relays for low voltage tie in by B.A.S..

Part 3 - Execution

3.1 Installation

- .1 Install all units as per manufacturers recommendations.
- .2 Provide each unit with shutoff valve and other accessories as per details on drawings.
- .3 Provide each unit with easily accessible automatic air vent at high point. If not easily accessible, extend vent to exterior surface of cabinet for easy servicing.
- .4 Suspend unit heaters from "speed grip nut" using rod.

End of Section

Part 1 General

1.1 Summary

- .1 Section includes design, performance criteria, refrigerants, controls, and installation requirements for Multistack air cooled centrifugal chillers.

1.2 References

- .1 Comply with the following codes and standards: (as adopted by each individual State): A.R.I. 550/590, A.N.S.I./A.S.H.R.A.E. 15, A.S.M.E. Section VIII, N.E.C., E.T.L., C.E., C.S.A., O.S.H.A.

1.3 Submittals

Submittals shall include the following:

- .1 Chiller dimensional drawings with elevation overview. Drawings to include required service clearances, location of all field installed piping and electrical connections.
- .2 A summary of all auxiliary utility requirements for normal system operation required. Auxiliary utility requirements include: electrical, water, and air. Summary of auxiliary equipment shall include quantity and quality of each specific auxiliary utility required.
- .3 Chiller Control documentation to include: Chiller control hardware layout, wiring diagrams depicting factory installed wiring, field installed wiring with points of connection, and points of connection for B.A.S. control/interface points.
- .4 Sequence of operation depicting overview of control logic used.
- .5 Installation and Operating Manuals.
- .6 Manufacturer certified performance data at full load in addition to either I.P.L.V. or N.P.L.V.

1.4 Quality Assurance

- .1 Regulatory Requirements: Comply with the codes and standards as defined in Section 1.02 titled References
- .2 Chiller is required to be run tested at manufacturer's facility to job specific requirements, prior to shipment. Report available upon request.

1.5 Delivery and Handling

- .1 Chiller(s) shall be delivered to the job site completely assembled and charged with complete refrigerant charge.

- .2 Installing contractor to comply with the manufacturer's instructions for transporting, rigging, and assembly of chiller.

1.6 Warranty and Start-up

- .1 Manufacturer shall provide full parts-only warranty coverage for entire chiller for a period of one year. All parts shall be warranted against defects in material and workmanship. Similar parts-only coverage shall be provided for the chillers compressors for a period of five years. The warranty period shall commence either on the equipment start-up date or six months after shipment, whichever is earlier.
- .2 Manufacturer shall provide the services of a Factory Authorized Service Engineer to provide complete start-up supervision. After start-up a Manufacturer's Representative shall provide a minimum of 8-hours of operator training to the owner's designated representative(s).

1.7 Maintenance

- .1 Maintenance of the chiller shall be the sole responsibility of the owner.

Part 2 Products

2.1 Operating Conditions

- .1 Provide Heatstack Water Heater with the capacity as scheduled on drawings at job site elevation listed in Section 15050.
- .2 The Heatstack Water Heater shall be designed to operate using R-410A Refrigerant.
- .3 The Heatstack Chiller shall be designed to provide hot water and/or chilled water for domestic or comfort conditions.
- .4 The liquid will be water containing corrosion inhibitors.
- .5 The Heatstack Water Heater shall be designed to operate using 575 volt, 3 phase, 60 (50) Hertz electrical power supply.

2.2 Heat Stack Water Heater

- .1 Approved manufacturers:
 - a. Multistack
 - b. Aermec

- .2 System Description: The Heatstack Water Heater shall incorporate Scroll-type compressors and can consist of a single or multiple compressors. Each refrigerant circuit shall consist of an individual compressor, common dual circuit or single condenser, dual or single circuit evaporator, electronic expansion valve, internal evaporator flow switch and control system. Circuits shall not contain more than (16) pounds of R-410A refrigerant.

2.3 General

- .1 The Heatstack Water Heater shall be E.T.L. listed in accordance with U.L. Standard 1995, C.S.A. certified per Standard C22.2#236.
- .2 Water Heaters shall ship wired and charged with refrigerant. All water heaters shall be factory run tested prior to shipment on an AHRI certified or 3rd party verified test stand.
- .3 Compressors, heat exchangers, piping and controls shall be
- .4 mounted in a heavy gauge, powder coated steel container. Electrical controls, contactors, and relays for each heater shall be mounted within that heater.

2.31 Chilled and Hot Water Connections: Each heater shall include

- .1 supply and return N.P.T. female adapters.

2.32 Evaporators and condensers: Each evaporator and condenser

- .1 shall be brazed plate heat exchangers constructed of 316 stainless steel; designed, tested, and stamped in accordance with U.L. 1995 code for 650 p.s.i.g. working pressure on the evaporator and 650 psig working pressure on the condenser.

2.33 Compressor: Each heater shall contain two hermetic scroll

- .1 compressors independently circuited and with internal spring isolation mounted to the module with rubber-in-shear isolators.

2.34 Central Control System.

- .1 The Heatstack Water Heater shall be equipped with a microprocessor-based leaving water controller. The Heatstack Water Heater shall have the capability to operate in response to heating set points.
- .2 The Heatstack shall monitor and report the
- .3 following on each refrigeration system:

- a. Discharge Pressure Fault
 - b. Suction Pressure Fault
 - c. Compressor Winding Temperature
 - d. Suction Temperature
 - e. Superheat
 - f. Chilled Water Entering and Leaving Temperature
 - g. Hot Water Entering and Leaving Temperature
 - h. Chilled Water and Hot Water Flow
- 2.35 In the case of a fault the entire Heatstack Water Heater will be shut down. This information shall be capable of being retrieved through the onboard U.S.B. port. A history of faults shall be maintained including date and time of day of each fault (up to the last 20 occurrences).
- 2.36 The control system shall monitor entering and leaving hot water temperatures to determine system load. Response times and set points shall be adjustable.
- 2.4 Interoperability Web Portal
- .1 The Chiller shall be capable of interfacing to a building automation system. Interface shall be accomplished using an Interoperability Web Portal and shall be capable of communication over BACNet M.S.T.P.
 - .2 Inputs/Outputs include:
 - 1. Remote Start/Stop
 - 2. E.C.W.
 - 3. L.C.W.
 - 4. E.C.H.W.
 - 5. L.C.H.W.
 - 6. Power Phase Monitor
 - 7. Evaporator Water Flow Switch Input
 - 8. Condenser Water Flow Switch Input
 - 9. Evaporator Pump Output

- .3 Each inlet water connection requires an in-line strainer of at least 30 mesh to prevent heat exchanger fouling. This can be provided by Multistack as an option for field installation.

2.5 Safeties, Controls and Operation

- .1 Heatstack Water Heater safety controls system shall be provided with the unit (minimum) as follows:
 - 1. Low evaporator refrigerant pressure
 - 2. Loss of flow through the evaporator
 - 3. Loss of flow through the condenser
 - 4. High condenser refrigerant pressure
 - 5. High compressor motor temperature
 - 6. Low suction gas temperature
 - 7. Low leaving evaporator water temperature
- .2 Failure of Heatstack Water Heater to start or Heatstack Water Heater shutdown due to any of the above safety cutouts shall be annunciated by display of the appropriate diagnostic description at the unit control panel. Alphanumeric codes shall be acceptable.
- .3 The Heatstack Water Heater shall be furnished with a controller as an integral portion of the Heatstack Water Heater control circuitry to provide the following functions:
 - 1. Provide automatic shutdown during periods when the load level decreases below the normal operating requirements of the Heatstack Water Heater. Upon an increase in load, the Heatstack Water Heater shall automatically restart provided no fault condition exists.
 - 2. Provisions for connection to automatically enable the Heatstack Water Heater from a remote energy management system.
- .4 Normal Heat stack Water Heater Operation
 - 1. The Heatstack Water Heater control system shall respond to leaving water temperature.
- .5 Power Phase Monitor
 - 1. Provide a Power Phase Monitor on the incoming power supply to the Heatstack Water Heater. This device shall prevent the Heatstack Water Heater from operating during

periods when the incoming power is unsuitable for proper operation.

2. The Power Phase Monitor shall provide protection against the following conditions:
 - a. Low Voltage (Brown-Out)
 - b. Phase Rotation
 - c. Loss of Phase
 - d. Phase Imbalance
 - e. High Voltage

Part 3 Installation

3.1 Piping System Flushing Procedure

- .1 Prior to connecting the Heatstack Water Heater to the condenser and chilled source water loop, the piping loops shall be flushed with a detergent and hot water (110-130 degrees Fahrenheit) mixture to remove previously accumulated dirt and other organics. In old piping systems with heavy encrustation of inorganic materials consult a water treatment specialist for proper passivation and/or removal of these contaminants.
- .2 During the flushing, a 30 mesh (max.) Y-strainers (or acceptable equivalent) shall be in place in the system piping and examined periodically as necessary to remove collected residue. The flushing process shall take no less than 6 hours or until the strainers when examined after each flushing are clean. Old systems with heavy encrustation shall be flushed for a minimum of 24 hours and may take as long as 48 hours before the filters run clean. Detergent and acid concentrations shall be used in strict accordance with the respective chemical manufacturer's instructions. After flushing with the detergent and/or dilute acid concentrations the system loop shall be purged with clean water for at least one hour to ensure that all residual cleaning chemicals have been flushed out.
- .3 Prior to supplying water to the Heatstack Water Heater the Water Treatment Specification shall be consulted for requirements regarding the water quality during Heatstack Water Heater. The appropriate Heatstack Water Heater manufacturer's service literature shall be available to the operator and/or service contractor and consulted for guidelines concerning preventative maintenance and off-season shutdown procedures.

3.2 Water Treatment Requirements

.1 Supply water for both the chilled water and hot water

circuits shall be analyzed and treated by a professional water treatment specialist who is familiar with the operating conditions and materials of construction specified for the Heatstack Water Heater heat exchangers and associated piping. Cycles of concentration shall be controlled such that recirculated water quality for the Heatstack Water Heater using 316 stainless steel brazed plate heat exchangers is maintained within the following parameters:

.1 P.H.	Greater than 7 and less than 9
.2 Total Dissolved Solids (T.D.S.)	Less than 1000 p.p.m.
.3 Hardness as CaCO ₃	30 to 500 p.p.m.
.4 Alkalinity as Ca CO ₃	30 to 500 p.p.m.
.5 Chlorides	Less than 200 p.p.m.
.6 Sulfates	Less than 200 p.p.m.

3.3 Warranty and Start-Up

- .1 Manufacturer's Warranty: Manufacturer shall provide full parts-only warranty coverage for entire chiller for a period of one year. All parts shall be warranted against defects in material and workmanship. Similar parts-only coverage shall be provided for the chillers compressors for a period of five years. The warranty period shall commence either on the equipment start-up date or six months after shipment, whichever is earlier.

End of Section

Part 1 - General

1.1 References

- .1 U.L. 508
- .2 N.E.C.

1.2 Quality Assurance

- .1 To ensure quality and minimize infantile failures at the jobsite, the complete V.F.D. shall be tested by the manufacturer. The V.F.D. shall operate a dynamometer at full load and the load and speed shall be cycled during the test.
- .2 All optional features shall be functionally tested at the factory for proper operation.

1.3 Submittals

- .1 Shop drawings must be submitted and reviewed by the Consultant prior to the contractor ordering or shipping any subject equipment. Payments will not be processed for equipment not properly documented and reviewed under the terms of submittal.
- .2 Submit manufacturer's performance data including dimensional drawings, power circuit diagrams, installation and maintenance manuals, warranty description, V.F.D.s F.L.A. rating, certification agency file numbers and catalog information.
- .3 The specification lists the minimum V.F.D. performance requirements for this project. Each supplier shall list any exceptions to the specification. If no departures from the specification are identified, the supplier shall be bound by the specification.
- .4 Submit a Harmonic Distortion Analysis for the jobsite location.
- .5 Harmonic filtering. The seller shall, with the aid of the buyer's electrical power single line diagram, providing the data required by I.E.E.E.-519, perform an analysis to initially demonstrate the supplied equipment will meet the I.E.E.E. standards after installation. If, as a result of the analysis, it is determined that additional filter equipment is required to meet the I.E.E.E. recommendations, then the cost of such equipment shall be included in the bid. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of I.E.E.E.-519 voltage and current distortion limits as shown in table 10.2 and 10.3 at the point of common coupling (P.C.C.). The P.C.C. shall be defined as the consumer-utility interface or primary side of the main distribution transformer.

1.4 Warranty

- .1 The V.F.D. shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the V.F.D. manufacturer.

1.5 Acceptable Manufacturers

- .1 Danfoss Graham
- .2 Trane TRC Series

Part 2 - Products

- 2.1 Furnish complete variable frequency drives as specified herein for the fans and pumps designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the V.F.D. enclosure, unless otherwise specified. V.F.D. shall be housed in a metal N.E.M.A. 1 enclosure, or other N.E.M.A. type according to the installation and operating conditions at the job site.
- 2.2 The V.F.D. shall convert incoming fixed frequency three-phase A.C. power into a variable frequency and voltage for controlling the speed of three-phase A.C. motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to negate the need for motor derating.
- 2.3 With the motor's rated voltage applied to the V.F.D. input, the V.F.D. shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. V.F.D.s utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not be overloaded under operating conditions.
- 2.4 The V.F.D. shall include a disconnect. Disconnect shall be fused or unfused as noted in the schedule.
- 2.5 The V.F.D. shall include a full-wave diode bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.
- 2.6 The V.F.D. and options shall be tested to A.N.S.I./U.L. Standard 508. The complete V.F.D., including all specified options, shall be assembled by the manufacturer, which shall be U.L.-508 certified for the building and assembly of option panels. Local representative panel shop assembly for option panels is not acceptable. The appropriate U.L. stickers shall be applied to both the drive and option panel, in the case where these are not contained in one panel. When these drives are to be located in Canada, the C.S.A. or C.-U.L. certifications shall apply. Both drive and option panel shall be manufactured in I.S.O. 9001 certified facilities.
- 2.7 The V.F.D. shall have D.C. link reactors on both the positive and negative rails of

- the D.C. bus to minimize power line harmonics. V.F.D.s without D.C. link reactors shall provide a minimum 5 percent impedance line reactor.
- 2.8 The V.F.D.'s full load amp rating shall meet or exceed N.E.C. Table 430-150. The V.F.D. shall be able to provide full rated output current continuously, 110 percent of rated current for 60 seconds and 160 percent of rated current for up to 0.5 second while starting.
- 2.9 The V.F.D. shall be able to provide full torque at any selected speed up to base speed to allow driving direct drive fans without derating.
- 2.10 An automatic energy optimization selection feature shall be provided standard in the drive. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide a 3 percent to 10 percent additional energy savings.
- 2.11 Input and output power circuit switching can be done without interlocks or damage to the V.F.D.
- 2.12 An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or decouple the motor from the load to run the test.
- 2.13 Galvanic and/or optical isolation shall be provided between the drive's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. Drives not including isolation on both analog I/O and discrete I/O shall include additional isolation modules.
- 2.14 V.F.D. shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted optimizing motor and drive efficiencies while reducing motor noise. Drives not incorporating this feature shall have a fixed carrier frequency above 10 k.H.z. without output current derating or reduced motor performance.
- 2.15 Protective Features
- .1 A minimum class 20 I²t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications shall be provided.
 - .2 Protection against input transients, loss of A.C. line phase, short circuit, ground fault, overvoltage, undervoltage, drive overtemperature and motor overtemperature. The V.F.D. shall display all faults in plain English. Codes are not acceptable.
 - .3 Protect V.F.D. from sustained power or phase loss. The V.F.D. shall provide full rated output with an input voltage as low as 90 percent of the nominal. The V.F.D. will continue to operate with reduced output with an input voltage as low as 164 volts for 208/230 volt units, and 313 volts for 460 volt units.

- .4 The V.F.D. shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.
- .5 Drive package shall include semi-conductor rated input fuses to protect power components.
- .6 To prevent breakdown of the motor winding insulation, the drive shall be designed to comply with I.E.C. Part 34-17. Otherwise the drive manufacturer must ensure that inverter rated motors are supplied.
- .7 Drive shall include a "signal loss detection" circuit to sense the loss of the control signal, and shall be programmable to react as desired in such instance.
- .8 Drive shall function normally when the keypad is removed while the drive is running and continue to follow remote commands. No warnings or alarms shall be issued.
- .9 Drive shall catch a rotating motor operating forward or reverse up to full speed.
- .10 V.F.D. shall be rated for 100,000 amp interrupting capacity (A.I.C.).
- .11 Drive shall include current sensors on all three output phases to detect and report phase loss to the motor. The V.F.D. will identify which of the output phases is low or lost.
- .12 Drive shall continue to operate without faulting until input voltage exceeds 300 volts on 208/230 volt drives, and 539 volts on 460 volt drives.

2.16 Interface Features

- .1 Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the drive and determine the speed reference.
- .2 Provide a 24 Volt D.C. output signal to indicate that the drive is in Auto/Remote mode.
- .3 Digital manual speed control. Potentiometers are not acceptable.
- .4 Lockable, alphanumeric backlit display keypad can be remotely mounted up to 10 feet away using standard 9-pin cable.
- .5 All keypads shall be identical and interchangeable.
- .6 To setup multiple drives, it shall be possible to upload all setup parameters to the drive's keypad, place that keypad on all other drives in turn and download the setup to each drive.
- .7 Display shall be programmable to display in 9 languages including English, Spanish and French.
- .8 The display shall have four lines, with 20 characters on three lines and

- eight large characters on one line.
- .9 A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the drive when the keypad is removed.
 - .10 A quick setup menu with factory preset typical H.V.A.C. parameters shall be provided on the drive eliminating the need for macros.
 - .11 The drive shall be fitted with an R.S. 485 serial communications port and be supplied with Windows® compatible software to display all monitoring, fault, alarm and status signals. The software shall allow parameter changes to be made to the drive settings, as well as storage of each controller's operating and setup parameters, and remote operation of the drive. The same software shall be used throughout the entire product range.
 - .12 The drive shall include as standard RS-485 communications capabilities to be connected at a future date to Johnson Controls N2 and/or Siemens Landis Division System 600 F.L.N. at no additional cost to the owner. The connection shall be software selectable by the user.
 - .13 As a minimum, the following points shall be controlled and/or accessible:
 - .1 Drive start/stop
 - .2 Speed reference
 - .3 Fault diagnosis
 - .4 Meter points
 - .1 Motor power in kilowatt
 - .2 Motor power in horsepower
 - .3 Motor kilowatt per hour
 - .4 Motor current
 - .5 Motor voltage
 - .6 Hours run
 - .7 Feedback signal 1
 - .8 Feedback signal 2
 - .9 D.C. link voltage
 - .10 Thermal load on motor
 - .11 Thermal load on drive
 - .12 Heatsink temperature

- .14 Two set-point control interface (P.I.D. control) shall be standard in the unit. Drive shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.
- .15 The sleep mode shall be functional in both follower mode and P.I.D. mode.
- .16 Floating point control interface shall be provided to increase/decrease speed in response to switch closures.
- .17 Four simultaneous displays shall be available. They shall include frequency or speed, run time, output amps and output power. Drives unable to show these four displays simultaneously shall provide panel meters.
- .18 Sleep mode shall be provided to automatically stop the drive when speed drops below set "sleep" level for a specified time. Drive automatically restarts when speed command exceeds set "wake" level.
- .19 Run permissive circuit shall be provided to accept a "system ready" signal to assure that the drive does not start until dampers or other auxiliary equipment are in the proper state for drive operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the V.F.D. to start.
- .20 An elapsed time meter and kilowatt-hour meter shall be provided.
- .21 The following displays shall be accessible from the control panel in actual units: Reference Signal Value in actual units, Output Frequency in Hertz or percent, Output Amps, Motor horsepower, Motor kilowatt, kilowatt-hour, Output Voltage, No Load Warning, D.C. Bus Voltage, Drive Temperature in degrees, and Motor Speed in engineering units per application (in percent speed, G.P.M., C.F.M.,). Drive will read out the selected engineering unit either in a linear, square or cubed relationship to output frequency as appropriate to the unit chosen.
- .22 The display shall be programmed to read in inches of water column (in-w.g.) for an air handler application, pressure per square inch (p.s.i.) for a pump application and temperature (degrees Fahrenheit) for a cooling tower application.
- .23 Four meter displays can be shown at once on the display. This allows the actual value of the follower signal to be shown simultaneously with the drive's response to that signal for ease in commissioning.
- .24 Drive will sense the loss of load and signal a no load/broken belt warning or fault.
- .25 If the temperature of the drive's heat sink rises to 80 degrees Celsius, the drive shall automatically reduce its carrier frequency to reduce the heat

sink temperature. If the temperature of the heat sink continues to rise, the drive shall automatically reduce its output frequency to the motor. As the drive's heat sink temperature returns to normal, the drive shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.

- .26 The V.F.D. shall have temperature controlled cooling fans for quiet operation and minimized losses.
- .27 The V.F.D. shall store in memory the last 20 faults and record all operational data.
- .28 Eight programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
- .29 Two programmable relay outputs, one Form C. 240 Volt A.C., one Form A 50 Volt A.C., shall be provided for remote indication of drive status.
- .30 Two programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include 0-10 Volts d.c., 0-20 m.A. and 4-20 m.A.
- .31 Two programmable 0 to 20 m.A. analog outputs shall be provided for indication of drive status. These outputs shall be programmable for output speed, voltage, frequency, amps and input kilowatt
- .32 Under fire mode conditions the V.F.D. shall automatically default to a preset speed.

2.17 Adjustments

- .1 V.F.D. shall have an adjustable carrier frequency in steps of not less than 0.1 kilohertz to allow tuning of drive to motor.
- .2 Sixteen preset speeds shall be provided.
- .3 Four acceleration and four deceleration ramps shall be provided. Accel and decel time shall be adjustable over the range from 0 to 3,600 seconds to base speed. The shape of these curves may be automatically contoured to prevent tripping.
- .4 Four current limit settings shall be provided.
- .5 If the V.F.D. trips on one of the following conditions, the V.F.D. shall be programmable for automatic or manual reset: undervoltage, overvoltage, current limit, inverter overload and motor overload.
- .6 The number of restart attempts shall be selectable from 0 through 20 and the time between attempts shall be adjustable from 0 through 600 seconds.
- .7 An automatic "on delay" may be selected from 0 to 120 seconds.

2.18 Bypass

- .1 A 3-contactor bypass shall be provided on all V.F.D.'s serving heating pumps or glycol pumps. Bypass is not required for air handling unit or rooftop units.
- .2 Provide a manual 3-contactor bypass consisting of a door interlocked main fused disconnect padlockable in the off position, a built-in motor starter and a four position DRIVE/OFF/LINE/TEST switch controlling three contactors. In the DRIVE position, the motor is operated at an adjustable speed from the drive. In the OFF position, the motor and drive are disconnected. In the LINE position, the motor is operated at full speed from the A.C. power line and power is disconnected from the drive so that service can be performed. In the TEST position, the motor is operated at full speed from the A.C. line power. This allows the drive to be given an operational test while continuing to run the motor at full speed in bypass. Customer supplied normally closed dry contact shall be interlocked with the drives safety trip circuitry to stop the motor whether in DRIVE or BYPASS mode in case of an external safety fault.
- .3 Service personnel shall be able to defeat the main power disconnect and open the bypass enclosure without disconnecting power. This shall be accomplished through the use of a specially designed tool and mechanism while meeting all local and national code requirements for safety.
- .4 Smoke purge circuitry shall be interconnected such that an external dry contact can be used in both drive and bypass mode.

2.19 Service Conditions

- .1 Ambient temperature, minus 10 to 40 degrees Celsius (14 to 104 degrees Fahrenheit).
- .2 0 to 95 percent relative humidity, non-condensing.
- .3 Elevation to 3,300 feet without derating.
- .4 AC line voltage variation, minus 10 to plus 10 percent of nominal with full output.
- .5 No side clearance shall be required for cooling of any units. All power and control wiring shall be done from the bottom.

Part 3 - Execution

3.1 Start-up Service

- .1 The manufacturer shall provide start-up and commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer's site. Sales

personnel and other agents who are not factory certified technicians for V.F.D. field repair shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the V.F.D., its options and its interface wiring to the building automation system. Start-up shall include customer operator training at the time of the equipment commissioning.

3.2 Examination

- .1 Contractor to verify that job site conditions for installation meet factory recommended and code-required conditions for V.F.D. installation prior to start-up, including clearance spacing, temperature, contamination, dust, and moisture of the environment. Separate conduit installation of the motor wiring, power wiring, and control wiring, and installation per the manufacturer's recommendations shall be verified.
- .2 The V.F.D. is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The V.F.D. shall not be operated while the unit is covered.

End of Section

1. Part 1 – General
 - 1.1. General
 - 1.1.1. Conform to General Provisions For Mechanical Divisions Section 23 05 01 H.V.A.C. General Requirements.
 - 1.2. Submittals
 - 1.2.1. Submit shop drawings and product data in accordance with Section 23 05 02 Documentation and Manuals.
 - 1.2.2. Indicate the following: complete specifications; weight; performance details.
 - 1.2.3. Provide data for inclusion in the Operating and Maintenance manuals in accordance with Section 23 05 02 Documentation and Manuals.
2. Part 2 - Products
 - 2.1. General
 - 2.1.1. Units shall be manufactured by International Environmental Corp. (I.E.C.) or Daikin as described herein. Acceptable equals are Trane and E.T.I.
 - 2.1.2. Units shall be listed by Electronics Testing Laboratories, Inc. with the E.T.L. listing indicating the units comply with the minimum requirements of the Canadian national product safety standard, U.L. 1995/C.S.A. C22.2 No. 236
 - 2.1.3. Elastomeric Closed Cell Foam Insulation shall conform to N.F.P.A. 90A for fire, smoke and melting; U.L. 181 for erosion; 25/50 rating for flame spread/smoke developed per A.S.T.M. E-84,U.L. 723 and N.F.P.A. 90A; antimicrobial performance rating of 0, no observed growth, per A.S.T.M. G-21
 - 2.2. Casing
 - 2.2.1. Provide horizontal hideaway type fan coils manufactured from heavy gauge galvanized steel. Horizontal units shall be designed to be ceiling hung. The interior surfaces shall be lined with ½ inch thick standard fiberglass insulation. Units shall be supplied with a ducted collar for supply duct connection. Where indicated on drawings provide horizontal units with a return air plenum. Return air plenum shall have filter frame for back return air. Filter shall be throwaway type.
 - 2.3. Fans and Motors
 - 2.3.1. Belt drive units shall have D.W.D.I. forward curved fans. Motors shall be O.D.P. type. Provide V belt drive with adjustable motor mount for belt tension and variable pitch motor sheave.
 - 2.4. Coils
 - 2.4.1. Coils shall be tested in accordance with A.H.R.I.

- 2.4.2. Fan coils shall have aluminum fin, copper tube coils with (manual) (automatic) air vents. Provide each unit with a drain pan fabricated of continuous (galvanized steel insulated with closed cell insulation and sealed with mastic) (stainless steel). Where indicated, include a separate heating coil for four pipe configuration.
- 2.5. Optional Controls (choose one)
 - 2.5.1. Supply control valves and actuator. Turn control valve body over to mechanical contractor for installtion
- 3. Part 3 - Exexution
 - 3.1. Installation
 - 3.1.1. Install fan coils in accordance with manufacturer's installation and maintenance instructions.
 - 3.1.2. Provide isolation valves and unions for each fan coil.

End of Section

Part 1 - General

1.1 General Requirements

- .1 The requirements of this section shall apply to all sections in Division 26 – Electrical.
- .2 All material, labour, equipment, and services required under this section shall be the full responsibility of the Contractor including any material, labour, equipment, and services provided by their sub-contractors.
- .3 Complete and submit the Supplemental Tender Form including list of equipment and materials to be used on this project and forming part of the tender documents.

1.2 Definitions

- .1 “Supply” shall mean supply only.
- .2 “Install” shall mean install and connect.
- .3 “Provide” shall mean supply, install, connect and test.
- .4 “Drawings and Specifications” shall mean Contract Documents.
- .5 “Authorities” or Authorities having jurisdiction” shall mean all agencies that enforce the applicable laws, ordinances, rules, regulations, or codes of the Place of Work.
- .6 “Work” shall mean all equipment, materials, labour, and permits to provide a complete and operational electrical system as detailed in the drawings and specifications.
- .7 “Owner” shall mean City of Peterborough.

1.3 Related Work

- .1 Division 1 – General
- .2 Division 21 – Sprinkler
- .3 Division 22 and 23 – Mechanical
- .4 Division 26 specifications form a part of the Contract Documents and shall be read, interpreted, and coordinated with all other Divisions. The Instructions to Bidders, General Conditions, General Requirements, Supplementary General Conditions and Amendments and Supplements thereto form a part of this Division and contain items related to the electrical work.
- .5 Division 27 – Communications
- .6 Division 28 – Fire Alarm, C.C.T.V. and Security

1.4 Intent

- .1 The drawings and specifications are not a detailed set of installation instructions. Drawings and specifications are complementary to one another and that which is shown on one is as binding as that which is shown on both.
- .2 The Consultant shall be immediately informed of any discrepancies between drawings and specifications leaving in doubt the true intent of the work.
- .3 Supply all labour, equipment, and materials necessary to install a complete and operational electrical system described herein and shown on the drawings.
- .4 It is the intent of these drawings and specifications to provide for an electrical installation complete and in operating condition. The responsibility for supplying and installing all material necessary to accomplish this, except where specifically noted that such work or materials is not included, shall be part of this section.
- .5 Assess and be familiar with existing site conditions prior to pricing and construction and allow for same in tender price.
- .6 All work must be done by qualified and certified persons in such line of work. Trade certificates must be available on demand.
- .7 All work shall be in accordance with standard industry practice accepted and recognized by the Consultant and the Trade.
- .8 The Contractor shall coordinate with and cooperate with all other trades prior to installation. Where work interferes with other trades due to failure to coordinate or cooperate, the work shall be removed and relocated as approved by the Consultant at no extra cost to the Owner.
- .9 The Consultant shall have the right to reject any work that does not conform to the Contract Documents and accepted standards of practice including but not limited to performance, quietness of operation, and finish.
- .10 Responsibility to determine which Division provides various products and work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of specifications.

1.5 Codes, Bylaws, Standards, and Regulations

- .1 The electrical system shall comply with the latest editions and revisions of applicable codes, bylaws, bulletins, standards, and regulations including but not limited to:
 - .1 Ontario Building Code

- .2 Ontario Electrical Safety Code
 - .3 Canadian Standards Association
 - .4 Local Municipal Codes
 - .5 Local Building Bylaws
 - .6 Ontario Occupational Health and Safety Act
 - .7 I.E.E.E.
- .2 Provide work in accordance with the requirements of all applicable government codes, local by-laws, underwriter's regulations base building standards, contract documents, and all authorities having jurisdiction.
 - .3 Where discrepancies occur between contract drawings and specifications and above codes and standards referred to herein, the Contractor is to notify the Consultant in writing and obtain clarification prior to proceeding with the work.
 - .4 Contractors shall not reduce the requirements on the contract drawings and specifications by applying any codes and standards referred to herein.
- 1.6 Permits and Fees
- .1 Apply for, obtain, and pay for all permits, fees, connections, inspections, licenses, certificates or charges necessary including all provincial and federal taxes including H.S.T.
 - .2 Coordinate all required inspections and give necessary notice to all authorities.
 - .3 Upon completion of project, provide inspection certificates confirming acceptance by all authorities having jurisdiction.
- 1.7 Contract Breakdown
- .1 After the tenders close, submit a breakdown of the price into scope and trades to the satisfaction of the Consultant based on the sections of the specifications.
 - .2 Breakdown shall include but not be limited to:
 - .1 Mobilization and shop drawing submission (minimum \$2,000.00)
 - .2 Permits and Fees
 - .3 Primary Duct Bank
 - .4 Secondary Duct Bank
 - .5 Secondary service and cables

- .6 Switchboard and motor control centers
 - .7 Panelboards and other miscellaneous distribution equipment
 - .8 Starters, contactors and control devices
 - .9 Feeder conduits
 - .10 Branch conduits
 - .11 Feeder cables
 - .12 Branch wiring
 - .13 Wiring for mechanical equipment
 - .14 Luminaires and poles (exterior)
 - .15 Luminaires (interior)
 - .16 Emergency Luminaires
 - .17 Fire Alarm System
 - .18 Voice and Data system rough-in
 - .19 Public Address (P.A.) System rough-in
 - .20 Security and C.C.T.V. System rough-in
 - .21 Close-out Submittals – Manuals & As-builts (minimum \$5,000.00)
- .3 Progress claims shall be based on the breakdown. Submit in table format showing contract amount, work complete to date as percentage, previous draw, amount this draw and balance for each line item.
- 1.8 Shop Drawings
- .1 Within thirty (30) days of award, the Contractor shall submit shop drawings of all equipment for the project.
 - .2 Prior to ordering of products or delivery of any products to job site, submit shop drawings electronically in P.D.F format to the Consultant for review and comments. Submit sufficiently in advance of construction to allow ample time for review. Size of shop drawings shall be 8.5 by 11 inches. 11 by 17 inches will be acceptable where appropriate for content and scale.
 - .3 Submittals shall contain but not be limited to details, dimensions, construction, size, arrangement, operating clearances, performance characteristics and capacities of products and parts of the work. Include wiring drawings and schematics showing interconnection with work of other Divisions.

- .4 Clearly mark each sheet of printed submittal material, using arrow, underlining or circling, to show particular sizes, dimensions, wiring diagrams, operating clearances, control diagrams, project identification, types, model numbers, ratings, capacities and options actually being proposed. Cross out non applicable material. Note on the submittal specified features such as special tank linings, pump seals, materials or painting.
 - .5 Prior to submission to the Consultant, the Contractor shall review all shop drawings. By this review the Contractor represents that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data or will do so and that he has checked and coordinated each shop drawing with the requirements of the Work and of the Contract Documents.
 - .6 The Contractor's review of each shop drawing shall be indicated by his approval stamp, date and signature on the front of each page. Drawings will not be considered if not previously checked by the Contractor.
 - .7 Review comments from Consultant. If shop drawings are modified, confirm changes before proceeding. If shop drawings are not approved, revise and resubmit changes for approval.
 - .8 Review of the shop drawings by the Consultant does not relieve the contractor or his supplier of the responsibility to provide the correct and complete equipment, material or installation.
 - .9 Keep one complete set of shop drawings at job site during construction.
 - .10 Include stamped reviewed shop drawings in the Maintenance Manuals.
- 1.9 Product Delivery Schedule
- .1 Within two (2) weeks from shop drawing review, a schedule must be submitted by the Contractor showing projected delivery dates of all products to meet required construction schedule.
- 1.10 Construction Meetings
- .1 The Electrical Contractor shall attend all site meetings unless otherwise pre-approved.
 - .2 Sub-trades shall attend site meetings as requested or as required.
- 1.11 As-built Drawings
- .1 Refer to Section 26-05-02.
 - .2 Maintain accurate, neat, and clean As-built Drawings on an on-going basis during construction to be reviewed periodically by the Consultant during construction.

- .3 As-built drawing mark-ups shall be made available at every site meeting or inspection.
- .4 As-built drawings shall include but not be limited to final location of all component locations and conduit runs.
- .5 Prior to Substantial Performance submit a complete set of As-built drawings in PDF format. The Contractor is responsible for providing red-line drawings indicating all As-built conditions.

1.12 E.S.A. Certificates

- .1 Furnish an unconditional Certificate of Acceptance from Electrical Safety Authority on completion of work. Arrange for interim and rough-in inspections. Arrange and pay for Occupancy Inspections if required for partial occupancies.
- .2 Incorporate a copy of the final E.S.A. Certificate in the operating and maintenance manual.

1.13 Maintenance Manuals

- .1 Refer to Section 26 05 02.
- .2 Provide the Owner with one (1) electronic copy on labeled on memory stick. Manuals shall contain and be tabbed in the following order:
 - .1 Table of Contents
 - .2 Contractor's, Manufacturer's and Supplier's Contact Information
 - .3 Warranty Letter
 - .4 Colour coding charts for access areas
 - .5 Final E.S.A. Certificate
 - .6 Fire Alarm Verification Report, Fire Alarm Certificate and Audibility Results
 - .7 Emergency Lighting Test Report
 - .8 ALL stamped approved shop drawings – Include a tab and blank section for any Owner supplied equipment
 - .9 Maintenance instructions, requirements, and schedule
 - .10 As-built drawings
- .3 Submit one (1) complete copy to the Consultant for review and approval. Revise based on any comments and resubmit all copies and electronic copy to Consultant.

1.14 Testing

- .1 The installation shall be free of open circuits and grounds.
- .2 On completion, measure insulation resistances and comply with Table 24 of Ontario Electrical Safety Code.
- .3 Test all wiring and connections for continuity and grounds before equipment is energized.
- .4 Before energizing system, check all connections and set and calibrate all relays and instruments for proper operation, obtain necessary clearances, approval and instructions from utility company.
- .5 Carry out all tests and furnish all equipment required to demonstrate safe and proper completion of the work, without cost to the Owner.
- .6 Check load balance on all feeders and make necessary adjustments to provide a "balanced" load.
- .7 Check voltage drop on all feeders/branch circuits and make necessary adjustments to provide a 2 percent voltage drop in all feeders and branch circuits and a 4 percent drop from supply side to point of utilization .
- .8 Fully coordinate all testing and commissioning with all trades, the Consultant, and authorities having jurisdiction.
- .9 Provide a minimum of forty-eight (48) hours written notice to all parties.

1.15 Demonstration and Training

- .1 Demonstrate and train the Owner on proper operation of the Electrical and Auxiliary systems.
- .2 Work with and assist Division 21, 22, 23 and 28 during training as required. Allow a minimum of four (4) separate two-hour sessions.
- .3 The Contractor shall arrange for all necessary personnel and equipment specialists to be in attendance for purposes of demonstration and training.
- .4 Provide instruction by a manufacturer's representatives as required too fully demonstrate the systems.
- .5 Demonstration and Training shall include but not be limited to:
 - .1 Training in the normal, abnormal and emergency operating condition of all systems provided under this Division.
 - .2 Review of all necessary maintenance procedures of all systems provided under this Division.
 - .3 Provision of a documented maintenance program covering all systems provided or modified under this contract.

- .4 Review of all close-out documentation including complete maintenance manuals and As-built drawings.
 - .6 Prepare a Training Agenda and Log for signature by all Participants. Submit to Consultant and include in Manuals.
- 1.16 Substantial Completion and Performance
- .1 Substantial completion and performance shall be determined and awarded by the Consultant.
 - .2 Complete the following to the satisfaction of the Consultant prior to request for substantial performance:
 - .1 Submit Electrical Safety Authority Certificate
 - .2 Submit reports as specified herein – fire alarm, emergency lighting
 - .3 Fire stopping
 - .4 Communication Test Report
 - .5 Security/C.C.T.V. Test Report
 - .6 As-built drawings
 - .7 Demonstration and Training
- 1.17 Warranty
- .1 Provide a one (1) year full parts and labour warranty for the new system from date of substantial completion.
 - .2 Submit warranty letter on Company letterhead signed by Company representative stating warranty terms including warranty period from date of substantial completion.

Part 2 - Products

2.1 General

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

- .5 Materials must be stored in original containers.
- .6 Remove and dispose of all redundant materials and garbage from site.

2.2 Selected Products and Equivalentents

- .1 Sections within Division 26 list "Acceptable Manufacturers" which must meet characteristics of the specified equipment and products for each section.
- .2 Base specified products are specified and/or shown on the drawings, and identified by manufacturer's name, type and catalogue number.
- .3 Any alternate manufacturers from base specified products and equipment must equal or exceed the quality, finish and performance of those base specified and/or shown, and not exceed the space requirements allotted on the drawings. Include costs for any associated work to accommodate such substitutions, including the Consultant's time and revisions to the work of other divisions.
- .4 If item or material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after the Contract has been awarded.
- .5 If item of size indicated is unobtainable, supply next larger size without additional charge.

2.3 Quality Of Product

- .1 All products provided shall be C.S.A. approved, approved by other relevant authorities.
- .2 If supplied products are not C.S.A. approved, obtain approval of provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- .3 All products provided shall be new including those not specified and shall be of a quality best suited to the purpose required and their use subject to approval by the Consultant.

2.4 Voltage Ratings

- .1 Operating Voltages: to C.A.N.3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 hertz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

2.5 Electric Motors, Equipment and Controls

- .1 Refer to Drawings for Contractor's equipment wiring responsibility.

- .2 Control wiring and conduit shall be covered under this Division except connections below 50 Volt which are related to control systems specified under Division 23.

2.6 Product Finishes

- .1 Shop drawings shall include finishes.
- .2 All cabinets, panelboards, switchboards, cable trays, etcetera shall be finished in ANSI 61 grey enamel unless otherwise specified.
- .3 Apply primer on all items which are to be finished on the job.
- .4 Repair dents and touch up all damaged finishes with matching finish, or if required by the Consultant or Owner, completely repaint or replace damaged surface at no extra cost to the Contract.

2.7 Access Doors

- .1 Provide access doors/panels as required for access, adjustment, operation, service, and maintenance.
- .2 Access doors shall be flush mounted 600 millimeters by 600 millimeters (24 inches by 24 inches) for body entry and 300 millimeters by 300 millimeters (12 inches by 12 inches) for hand entry. Doors to open 180 degrees, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.
- .4 Access Doors/Covers – Flush Access Door – Drywall Area
 - .1 Acudor DW-5040 Series flush to surface for drywall, satin coat steel with white baked enamel finish, formed door panel, flanged on four sides, 20 gauge. Galvanized frame with multiple bends and integral taping bead, 26 gauge. Concealed hinge, stainless steel screwdriver operated cam latch.
- .5 Access Doors/Covers – Flush Access Door – Universal
 - .1 Acudor UF-5000 Universal Access Doors, 14 gauge (1.7 millimeters) steel, baked enamel prime coat, continuous concealed hinge, with positive and self-opening screwdriver operated lock.
- .6 Acceptable Manufacturers:
 - .1 Acudor
 - .2 Zurn
 - .3 Nailor Industries
 - .4 Le Hage

2.8 Floor Mounted Equipment

- .1 Mount Switchboards, Motor Control Centres and all other floor mounted electrical equipment on chamfered edge housekeeping pads, minimum of 100 millimeters (4 inches) high and 150 millimeters (6 inches) larger than equipment dimensions all around.

2.9 Sleeves

- .1 Provide sleeves for all cables passing through masonry, concrete or fire rated assemblies unless run in conduit.
- .2 Sleeves shall be E.M.T. conduit complete with bushing.

2.10 Fire Stopping

- .1 This Contractor shall work with all other Contractors on the project in providing one common method of fire stopping all penetrations made in the fire rated assemblies.
- .2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.
- .3 Do not use cementious or rigid seals around penetrations for pipe, ductwork, or other mechanical items.
- .4 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.
- .5 Comply with the requirements of C.A.N.4-S115-M35, and do not exceed opening sized for which they have been tested.
- .6 Systems to have an F. or F.T. rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide "fire wrap" blanket around services penetrating fire walls. Extent of blanket must correspond to U.L.C. recommendations.
- .7 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.
- .8 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.
- .9 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.
- .10 Firestopping shall be inspected and approved by local authority prior to concealment of enclosure.
- .11 Install material and components in accordance with U.L.C. certification,

manufacturer's instructions and local authority.

- .12 Submit product literature and insulation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and Consultant.
- .13 Acceptable Manufacturers:
 - .1 Fryesleeve Industries Inc.
 - .2 General Electric Pensiil Firestop Systems
 - .3 International Protective Coatings Corp.
 - .4 Rectorseal Corporation (Metacaulk)
 - .5 Proset Systems
 - .6 3.M.
 - .7 AD Systems
 - .8 Hilti

Part 3 - Execution

3.1 Site Examination

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

3.2 Interference and Coordination Drawings

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

3.3 Separation of Services

- .1 Maintain separation between electrical wiring system and building piping, ductwork, etcetera so that wiring system is isolated (except at approved connections to such systems) to prevent galvanic corrosion.
- .2 In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.
- .3 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from ceiling installer, and approved clips or hangers are used.

3.4 Workplace Safety

- .1 The workplace must be kept safe at all times.
- .2 Conform to all ministries of labour, and health and safety regulations at all times.
- .3 Use ladders and proper techniques as approved by the ministry of labour to perform all work.
- .4 Cover all holes/openings and provide barriers around hazards, etcetera to ensure occupants and workers are not at risk.
- .5 Where work does not conform to such regulations, stop work immediately and report the situation to the Owner's representative or Consultant or rectify the situation immediately.
- .6 Report any hazards or concerns to the Owner's representative immediately.
- .7 Conform to the Owner's safety requirements and construction regulations.

3.5 Temporary Requirements

- .1 Provide grounded extension cords and temporary lights required for work.
- .2 Any specific task lighting required on site is the responsibility of this Division.

3.6 Location Of Luminaires

- .1 Locations may have to be revised to suit construction and equipment arrangements and it is expected that such changes will not result in additional cost to the Owner, provided that no additional labour or material is required and installation has not been completed.

3.7 Mounting Heights

- .1 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise. Coordinate with block coursing (if applicable).

- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
 - .3 Install electrical equipment at following heights unless indicated otherwise (measurement to the centre of device unless specified):
 - .1 Local switches: 900 millimeters (36 inches) - 1100 millimeters (43 inches)
 - .2 Wall receptacles:
 - .1 General: 400 millimeters (16 inches)
 - .2 Above top of continuous baseboard heater: 200 millimeters (8 inches)
 - .3 Above top of counters or counter splash backs: 100 millimeters (4 inches)
 - .4 In mechanical rooms: 1200 millimeters (48 inches)
 - .3 Panelboards: as required by Code or 1400 millimeters (56 inches)
 - .4 Voice/Data outlets: At height of adjacent outlet or at 400 millimeters (16 inches)
 - .5 Voice outlet for phone: 900 millimeters (36 inches) - 1100 millimeters (43 inches)
 - .6 Fire alarm pull stations: 1200 millimeters (47 inches)
 - .7 Fire alarm horns: 150 millimeters (6 inches) below ceiling and maximum 2300 millimeters (90 inches) above finished floor (measured to top of device)
 - .8 Fire alarm visual signal device: entire lens is 2000-2400 millimeters (78 inches-94 inches)
 - .9 Fire alarm combination visual and signal devices: Conform to 3.7.3.7 and 3.7.3.8.
 - .10 Thermostat: 1200 millimeters (47 inches)
 - .11 Space Sensors: 1400 millimeters (55 inches)
 - .12 Clocks: 2100 millimeters (84 inches)
- 3.8 Repairs, Cutting and Restoration
- .1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match finishes of same materials.

- .2 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work and/or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
- .3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.
- .4 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

3.9 Painting

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

3.10 Concealment

- .1 All equipment, components, piping, and conduit shall be concealed in ceiling spaces, bulkheads or walls where possible unless otherwise noted on the drawings or approved by the Owner or Consultant.
- .2 Exposed equipment, components, piping, and conduit installed in unfinished areas, shall be installed as high as possible. Run piping and conduit tight to roof deck and down columns.

3.11 Clearances and Accessibility

- .1 Install all work for easy access for adjustment, operation, and maintenance.
- .2 Maintain clearances for all components as per code and manufacturer's instructions.
- .3 Provide access panels of adequate size as required to access components in concealed areas. Do not install access doors in specialty walls or ceilings.
- .4 Provide fire rated access doors shall be installed in fire separations and match rating of separation.

3.12 Equipment and System Protection

- .1 Protect components and materials from damage in storage and on site before, during, and after installation until final acceptance.
- .2 Protect inside and outside of components from dust and debris with appropriate covers that will withstand through the construction.
- .3 Where equipment and system components become dirty or damaged, clean and repair to new condition to the satisfaction of the Consultant at the expense of this Contractor.

3.13 Supports

- .1 Provide all miscellaneous metals and materials as required for support, hanging, anchoring, and guiding of all components.
- .2 All supports must be securely mounted to structures.

3.14 Concrete Pads

- .1 Provide 100 millimeters (4 inches) high concrete pads under all floor mounted electrical equipment including but not limited to M.C.C.s, switchboards and transformers. Concrete pad shall extend 100 millimeters (4 inches) beyond footprint of equipment.
- .2 Paint top and all sides of pad with two (2) coats of yellow paint.

3.15 Location of Outlets

- .1 Do not install outlets back-to-back in wall. Allow minimum 150 millimeters (6 inches) horizontal clearance between boxes.
- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3 meters (10 feet) and information is given before installation.
- .3 Locate light switches on latch side of doors. Locate disconnect devices in mechanical rooms on latch side of door.

3.16 Fire Stopping

- .1 Refer to Part 2 herein.

3.17 Cleaning

- .1 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition.

3.18 Owner Supplied Equipment

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

3.19 Equipment Identification

- .1 Identify electrical equipment with nameplates as follows:
- .2 Nameplates:
 - .1 Lamacoid 3 millimeters (1/8 inches) thick plastic engraving sheet, black face, white core, mechanically attached with self-tapping screws.

Nameplate Sizes

Size 1	9 millimeters x 50 millimeters (3/8 inches x 2 inches)	1 line	3 millimeters (1/8 inches) high letters
Size 2	12 millimeters x 70 millimeters (1/2 inches x 2-1/2 inches)	1 line	5 millimeters (3/16 inches) high letters
Size 3	12 millimeters x 70 millimeters (1/2 inches x 2-1/2 inches)	2 lines	3 millimeters (1/8 inches) high letters
Size 4	20 millimeters x 90 millimeters (3/4 inches x 3-1/2 inches)	1 line	9 millimeters (3/8 inches) high letters
Size 5	20 millimeters x 90 millimeters (3/4 inches x 3-1/2 inches)	2 lines	5 millimeters (3/16 inches) high letters
Size 6	25 millimeters x 100 millimeters (1 inches x 4 inches)	1 line	12 millimeters (1/2 inches) high letters
Size 7	25 millimeters x 100 millimeters (1 inches x 4 inches)	2 lines	6 millimeters (1/4 inches) high letters

- .3 Wording on nameplates labels to be approved by Consultant prior to manufacture.
- .4 Allow for average of twenty-five (25) letters per nameplate.
- .5 Identification to be English.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .7 Nameplates for disconnects, starters and contactors must indicate equipment being controlled and voltage.
- .8 Nameplates for transformers must indicate transformer label as indicated and capacity, primary, and secondary voltages.

3.20 Wiring Identification

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to C.S.A. C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

3.21 Conduit and Cable Identification

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 meters (45 foot) intervals.
- .3 Colour bands must be 25 millimeters (1 inches) wide.

	<u>Prime</u>
Up to 208 volt	yellow
Voice system	green
Data system	orange
Security	brown
Public address	black
Fire alarm	red

- .4 This Contractor must paint all system junction boxes and covers in conformance with the above schedule.

3.22 Wiring Terminations

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

3.23 Warning Signs

- .1 Meet requirements of Electrical Safety Authority and Consultant.
- .2 Provide porcelain enamel signs, with a minimum size of 175 millimeters by 250 millimeters (7 inches by 10 inches).

3.24 Load Balance

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as

required to obtain best balance of current between phases and record changes.

- .2 Measure phase voltages at loads and adjust transformer taps to within 2 percent of rated voltage equipment.
- .3 Submit at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

3.25 Field Quality Control

- .1 Conduct and pay for following tests:
 - .1 Power distribution system including phasing, voltage, grounding, and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operating systems where applicable.
 - .5 Systems: fire alarm system.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 Insulation resistance testing.
 - .1 Megger circuits, feeders and equipment up to 350 Volts with a 500 Volt instrument.
 - .2 Megger 350-600 Volt circuits, feeders and equipment with a 1000 Volt instrument.
 - .3 Check resistance to ground before energizing.
- .4 Carry out tests in presence of Consultant.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit test results for Consultant's review.

3.26 Coordination of Protective Devices

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as indicated on drawings or as determined from coordination study.

3.27 Field Review and Deficiencies

- .1 The Contractor shall notify the Consultant when the job is ready for field review at various stages including rough-in stages.
- .2 During the course of construction, the Consultants will monitor construction and provide written reports of work progress, discussions and deficiencies.
- .3 The Contractor shall correct all deficiencies within the work period prior to the next review.
- .4 The Contractor shall not conceal any work until inspected. Where work was concealed, the Contractor shall remove and replace tiles, coverings or other obstructions to allow proper inspection at the Contractor's expense.
- .5 Upon completion of the project the Consultant will do a final review. Upon receiving the final inspection report, the Contractor must correct and sign back the inspection report indicated all deficiencies are completed. A re-inspection will only be done once the Consultant receives this in writing. Where the Consultant performs the re-inspection and the work is not complete, the Contractor is responsible for reimbursing the Consultant for the field review. The fee for additional reviews will be at the Consultant's hourly rates plus mileage and applicable taxes to be paid directly to the Consultant prior to performing the next field review.

End of Section

Part 1 - General

1.1 Work Included

- .1 Operating and Maintenance Manuals
- .2 Assembly of certificates and tests reports
- .3 Assembly of shop drawings
- .4 Assembly of equipment and systems operating and maintenance instructions
- .5 Assembly of identification schedule
- .6 As Built Drawings

1.2 Related Work

- .1 Division 1
- .2 General Electrical Requirements – Section 26 05 01

Part 2 - Products

2.1 Operation and Maintenance Materials

- .1 Provide two (2) 8½ inch by 11 inch, 3 ring type catalogue binders, labeled front and spine, with plastic tab dividers and Table of Contents. Also provide one (1) complete manual in electronic P.D.F. format on labeled memory stick.
- .2 Manufacturer's data section is to be indexed and ordered to exactly match the sections of the specifications. Each section of the manufacturer's data section is to include an up to date copy of the equipment schedule for that section. The schedule is to be revised to suit all addenda, change orders and field changes, as well as manufacturers and model numbers matching the equipment supplied.
- .3 Assemble or develop complete and correct documentation for the operation and preventative maintenance of equipment and systems provided.
- .4 Assemble or develop copies of all certified shop drawings and material required to complete the documentation. This generally includes but is not limited to the following:
 - .1 Table of Contents
 - .2 Contractor's, Manufacturer's and Supplier's Contact Information
 - .3 Warranty Letter

- .4 Colour coding charts for access areas
- .5 Final E.S.A. Certificate
- .6 Fire Alarm Verification Report, Fire Alarm Certificate and Audibility Results
- .7 Emergency Lighting Test Report
- .8 ALL stamped approved shop drawings – Include a tab and blank section for any Owner supplied equipment
- .9 Maintenance instructions, requirements, and schedule
- .10 As Built drawings

2.2 As Built Drawings

- .1 As Built drawings shall be kept up to date on an ongoing basis during construction for periodic review by the Consultant. As Built drawings shall always be kept in the same location on site known to the Consultant.
- .2 Contractors shall certify that final reproducible As Built drawings to be correct by notation and signature on the drawings.
- .3 As Built drawings shall precisely identify the configuration, size and location of all systems and equipment installed under this Division.
- .4 As Built drawings must be submitted in AutoCAD as specified herein.

2.3 Test Reports

- .1 Include a copy of all test reports for inclusion in Operating and Maintenance Manuals.

2.4 Demonstration and Training Reports

- .1 Refer to Section 26 05 01 – General Electrical Requirements
- .2 Include a copy of all Training literature in the Operating and Maintenance Manuals.
- .3 Include a copy of the signed and dated Training Log.

Part 3 - Execution

3.1 General

- .1 Substantial Performance will not be granted until the hard copies and electronic copy of the complete manual have been submitted by the Contractor and reviewed and accepted by the Consultant.
- .2 Submit a draft copy of the manual to the Consultant for review prior to final submission of all copies.

- .3 Provide one (1) electronic copy in P.D.F format to the Consultant for final acceptance.

3.2 As Built Drawings

- .1 Prior to Substantial Performance submit a complete set of As Built drawings in P.D.F. format. The Contractor is responsible for providing red-line drawings indicating all As Built conditions. Make any changes as requested by the Consultant after review.
- .2 Substantial performance will not be granted until the As Built drawings have been submitted to the Consultant.

End of Section

Part 1 - General

1.1 General

- .1 The following specification represents the minimum standard required for installation of basic electrical components.

1.2 Work Included

- .1 Refer to Section 26 05 01.
- .2 Work to be done under this Section includes labour, materials, and equipment required to install, test and operate Electrical and Communication Systems.
- .3 Removal of all redundant wiring and conduit including where specifically requested by the Owner.

1.3 Codes and Standards

- .1 Ontario Electrical Safety Code – Current Edition.
- .2 C.S.A.
- .3 U.L.C.
- .4 American Electronic/Telecommunication Industry Association
- .5 Commercial Building for Telecommunications Pathways and Spaces
- .6 Local Telephone Company requirements
- .7 Local Codes and Requirements

1.4 Submittals

- .1 Shop Drawings:
 - .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
 - .2 Shop drawings shall include manufacturer, model numbers, electrical data, wiring diagrams, and indicate conformance to above reference standards.
 - .3 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
 - .4 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.
- .2 Operation and Maintenance Data:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.

1.5 Standard of Materials

- .1 Materials and equipment are specifically described and named in this Specification in order to establish a standard of material and workmanship.
- .2 Materials required for performance of work shall be new and the best of their respective kinds and of uniform pattern throughout work.
- .3 Equipment items shall be standard products of approved manufacture. Identical units of equipment shall be of same manufacture.
- .4 Chemical and physical properties of materials and design performance characteristics and methods of construction and installation of items of equipment, specified herein, shall be in accordance with latest issue of applicable Standards or Authorities when such are either mentioned herein, or have jurisdiction over such materials or items of equipment.
- .5 Materials shall bear approval labels as required by Code and/or Inspection Authorities.
- .6 Install materials in strict accordance with manufacturer's recommendations.
- .7 Include items of material and equipment not specifically noted on Drawings or mentioned in Specification but which are necessary to make a complete and operating installation.
- .8 Remove materials, condemned as not approved for use, from job site and deliver and install suitable approved materials in their place.
- .9 Where a specific manufacturer is noted herein, other manufacturers may be considered where approved by the owner.

Part 2 - Products

2.1 General

- .1 Provide all equipment as per the following description to complete the entire works as shown on drawings and as indicated in the specifications to provide a complete and operational system.
- .2 Coordinate with other trades to provide the components required to make all systems operational – see mechanical schedules for details of equipment provided to make sure the works are complete.

2.2 Outlet Boxes

- .1 Outlet boxes shall conform to C.S.A. Standard C22.2 No. 18-1972.
- .2 Ceiling boxes shall be 103 millimeters octagon or square, complete with fittings, where required to support fixtures.
- .3 Switch and receptacle boxes shall be:
 - .1 103 millimeters square with plaster ring, where flush mounted in plaster walls.
 - .2 No. 1104, where flush mounted in wood or drywall, with stud fasteners as required.
 - .3 Masonry boxes in masonry walls.
- .4 Where boxes are surface mounted in unfinished areas they shall be F.S. conduits.
- .5 Standard outlet boxes shall be manufactured from code gauge galvanized steel.
- .6 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area it is to be installed.
- .7 Boxes shall be of a size suitable for the number and size of conductors and the space requirements for the wiring device.

2.3 Conduit Accessories, Condulets and Fittings

- .1 Conduit accessories, condulets and fittings shall conform to C.S.A. Standard C22.2 No. 18-1972.
- .2 Rigid conduit bushings shall be as manufactured by:
 - .1 Thomas and Betts Limited – Series 5031
 - .2 Efcor of Canada Limited – Series 720B
 - .3 Commander / Iberville
- .3 E.M.T. Connectors shall be steel set screw type as manufactured by:
 - .1 Thomas and Betts Limited – Steel City TC 121E Series
 - .2 Efcor of Canada Limited – Series 720B
 - .3 Commander / Iberville
- .4 Ground Bushing shall be as manufactured by:
 - .1 Thomas and Betts – Blackjack or 1220 Series
 - .2 Efcor of Canada Limited

- .3 Commander / Iberville
- .5 Flexible conduit connectors shall be as manufactured by:
 - .1 Thomas and Betts Limited – Series 3110
 - .2 Efcor of Canada Limited – Series 1001B
 - .3 Commander / Iberville
- .6 Conduit fittings shall be as manufactured by:
 - .1 Crouse-Hinds of Canada Limited
 - .2 Kondu Mfg. Co. Limited
 - .3 Thomas and Betts Limited
 - .4 Killark of Canada
 - .5 Efcor of Canada Limited
 - .6 Commander / Iberville
- .7 Steel conduit shall be as manufactured by:
 - .1 Conduits National Co. Limited
 - .2 MBF Industries
- .8 Aluminum conduits shall be as manufactured by:
 - .1 Alcan Canada Products Limited
- .9 Terminate rigid conduit entering boxes or enclosures with nylon insulated steel threaded bushings.
 - .1 Thomas and Betts – 8125 Series
- .10 Terminate E.M.T. entering boxes or enclosures with nylon insulated steel threaded bushings.
- .11 Terminate flexible conduit entering boxes or enclosures with nylon insulated steel connectors.
 - .1 Thomas and Betts – 5332 Series
- .12 Install wall entrance seals where conduits pass through exterior walls below grade.
- .13 Provide expansion coupling in conduit runs at building expansion joints and in long runs subject to thermal expansion, all in accordance with manufacturer recommendations.
- .14 All cabling shall be run in E.M.T. conduit unless otherwise approved.

- .15 B.X. cable is acceptable for short drops to light fixtures to a MAXIMUM LENGTH OF 1500 millimeters. Any installations exceeding 1500 millimeters WILL BE REMOVED AND REPLACED AT THE CONTRACTORS EXPENSE. All installations of B.X. cable shall be complete with anti-short bushings at all stripped ends as per O.E.C. 12-608(1)(a). Connectors for B.X. cable shall be Crouse Hinds L16ST.
- .16 Rigid P.V.C. (unplasticized) conduit shall be C.S.A. approved according to C.S.A. Standard C22.2 No. 136.
- .17 Pull Cords/Strings
 - .1 Nylon twine

2.4 Conductors, Wires and Cables

- .1 Wiring installed in conduit, unless otherwise noted, shall be copper 600 volt RW75XLPE, RWU75XLPE or T-75 nylon jacket as per the requirements on the plans. It is the responsibility of the contractor to verify all equipment termination temperature and adjust wire size/rating to suit.
- .2 Lighting and power wiring shall be copper, minimum No. 12 gauge. Size wires for 2 percent maximum voltage drop to farthest outlet on a maximum 80 percent loaded circuit.
- .3 Conductors shall be colour coded. Conductors No. 10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No. 8 gauge and larger may be colour coded with adhesive colour coding tape but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible.
- .4 Colour Coding shall be as follows:
 - .1 Phase "A" – Red
 - .2 Phase "B" – Black
 - .3 Phase "C" – Blue
 - .4 Control – Orange
 - .5 Ground – Green
 - .6 Neutral – White
- .5 Wire shall be as manufactured by:
 - .1 Nexans
 - .2 Industrial Wire and Cable (1970) Limited
 - .3 Southwire Canada

- .4 Prysmian Cables and Systems Limited (formerly Pirelli Cables Limited)
 - .6 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.
 - .7 Splice wire, up to and including No. 6 gauge, with nylon insulated expandable spring type connectors.
 - .1 Thomas and Betts – Marr Max Series
 - .8 Splice large conductors using compression type connections insulated with heat shrink sleeves.
 - .1 Thomas and Betts – 5400 Series lugs and heat shrink type #s series
 - .9 Where colour coding tape is utilized, it shall be applied for a minimum of 2 inches at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition. Colour coding shall also apply to bussing in panels and, switchgear, disconnects, and metering cabinets.
- 2.5 Splitters
- .1 Splitters must conform to C.S.A. C22.2 No. 76 (latest edition).
 - .2 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
 - .3 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
 - .4 At least three spare terminals on each set of lugs in splitters less than 400 amps.
 - .5 Splitter length must match arrangement of equipment unless indicated otherwise.
- 2.6 Junction Boxes and Pull Boxes
- .1 Junction and pull boxes must conform to C.S.A. C22.2 No. 40 (latest edition).
 - .2 Welded steel construction with screw-on flat covers for surface mounting.
 - .3 Covers with 25 millimeters (1 inch) minimum extension all around, for flush-mounted pull and junction boxes.
- 2.7 Switches
- .1 Local switches shall be 15 amps or 20 amps, single pole, double pole, three-way, four-way, keyed, or motor rated complete with pilot light. Switches to be silent, A.C. type and C.S.A. listed, specification grade.

Provide switches rated to suit system voltage.

- .2 Manually operated general purpose with the following features:
 - .1 Terminal holes approved for No. 10 A.W.G. wire.
 - .2 Silver alloy contacts
 - .3 Urea or melamine molding for parts subject to carbon tracking
 - .4 Suitable for back and side wiring
 - .5 Toggle style
- .3 Toggle operated fully rated for tungsten filament and L.E.D. lamps
- .4 Up to 80 percent of rated capacity of motor loads.
- .5 Switches and receptacles shall be of the same manufacturer throughout except where a specified item is not made by that manufacturer.
- .6 Provide white colour (to be confirmed at shop drawing review).
- .7 Catalogue numbers listed below have been used to indicate quality standards.
 - .1 Single Pole Hubbell 1221/18221 Series
 - .2 Double Pole Hubbell 1222/18222 Series
 - .3 Three-Way Hubbell 1223/18223 Series
 - .4 Four-Way Hubbell 1224/18224 Series
 - .5 Keyed Hubbell HBL1221L + 2 matching keys Hubbell HBL1209
 - .6 Motor rated Hubbell HBL1221PL c/w pilot light (min 20 amps)
- .8 Acceptable Manufacturers:
 - .1 Hubbell of Canada Limited
 - .2 Leviton
 - .3 Legrand

2.8 Dimmer Control

- .1 Dimmers to be provided with following features:
 - .1 Rating of 20 amps 120 volts
 - .2 Wattage to suit load as indicated. Minimum wattage to be 1000 watts.

- .3 Linear slide control.
- .4 Dimmer must be rated for L.E.D. control and provide full range control from zero to full intensity.
- .5 On/Off switch
- .6 Mountable in a single gang or multi-ganged box as required.
- .7 Cover plate to match other wiring devices

2.9 Occupancy Sensors

- .1 Ceiling mounted sensors shall be Dual Technology capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.
- .2 Wall mounted sensors shall be Single Technology capable of detecting presence in the control area by detecting passive infrared heat changes
- .3 Ceiling sensors shall use patent pending ultrasonic diffusion technology that spreads coverage to a wider area.
- .4 Ceiling sensors shall utilize Dual Sensing Verification Principle for coordination between ultrasonic and PIR technologies. Detection verification of both technologies must occur in order to activate lighting systems. Upon verification, detection by either shall hold lighting on.
- .5 Ceiling sensors shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off.
- .6 Ceiling sensors shall be ceiling mounted with a flat, unobtrusive appearance and provide 360 degrees coverage.
- .7 Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 kilohertz. It shall utilize Advanced Signal Processing that automatically adjusts the detection threshold dynamically to compensate for changing levels of activity and airflow throughout controlled space.
- .8 To avoid false ON activations and to provide immunity to R.F.I. and E.M.I., Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.
- .9 The P.I.R technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength I.R., such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects I.R. reception.

- .10 Sensors shall have a time delay that is adjusted automatically (with the SmartSet setting) or shall have a fixed time delay of 5 to 30 minutes, set by DIP switch.
 - .11 Sensors shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.
 - .12 Ceiling sensors shall have a built-in light level sensor that works from 10 to 300 foot candles.
 - .13 Sensors shall have a manual on function that is facilitated by installing a momentary switch.
 - .14 Sensors shall have eight occupancy logic options that give the ability to customize control to meet application needs.
 - .15 The sensors shall feature terminal style wiring, which makes installation easier.
 - .16 Sensors shall have an additional single-pole, double throw isolated relay with normally open, normally closed and common outputs. The isolated relay is for use with H.V.A.C. control, data logging, and other control options.
 - .17 Each sensing technology shall have an L.E.D. indicator that remains active at all times in order to verify detection within the area to be controlled. The L.E.D. can be disabled for applications that require less sensor visibility.
 - .18 To ensure quality and reliability, sensor shall be manufactured by an I.S.O. 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1 percent.
 - .19 Sensors shall have standard 5 year warranty and shall be U.L. and C.U.L. listed.
 - .20 Sensorworx is an acceptable alternate for occupancy sensor lighting control.
- 2.10 Receptacles
- .1 Receptacles shall conform to C.S.A. 22.2 No. 42 (latest edition).
 - .2 Receptacles shall be specification grade of amperage and voltage indicated on the drawings.
 - .3 Manually operated general purpose with the following features:
 - .1 Terminal holes approved for No. 10 A.W.G. wire.
 - .2 Break-off links for use as split receptacles

- .3 Urea or melamine molding for parts subject to carbon tracking
- .4 Suitable for back and side wiring (eight back wired entrances, four side wiring screws)
- .5 Triple wipe contacts and riveted grounding contacts
- .6 Tamper resistant
- .4 Switches and receptacles shall be of the same manufacturer throughout except where a specified item is not made by that manufacturer.
- .5 Provide white colour (to be confirmed at shop drawing review).
- .6 Receptacles shall be as listed below:
 - .1 15 ampere, 120 volts, single phase grounded duplex tamper resistant receptacle shall be N.E.M.A.-U-ground type C.S.A. Configuration 5-15R.
 - .2 20 ampere, 120 volts, single phase grounded duplex tamper resistant receptacle shall be N.E.M.A.-U-ground type C.S.A. Configuration 5-20RA.
 - .3 15 ampere, 120 volts, weatherproof receptacles shall be equal to those above but complete with gasketed cast plate and hinged covers.
- .7 Other types of receptacles shall be provided as shown on Drawings.
- .8 Catalogue numbers listed below have been used to indicate quality standards.

.1	Standard Duplex	Hubbell BR15WHITR
.2	T-Slot	Hubbell BR20WHITR
.3	Controlled	Hubbell BR15C2GNTR
.4	Controlled T-Slot	Hubbell BR20C2GNTR
.5	G.F.I.	Hubbell GFTRST15W
.6	G.F.I. T-Slot	Hubbell GFTRST20W
.7	U.S.B. Duplex	Hubbell USB15C5W
.8	U.S.B. Only	Hubbell USB4W
.9	Twist Lock	Hubbell HBL23XX
.10	Dryer	Hubbell HBL9430A
.11	Range	Hubbell HBL9450A

.9 Acceptable Manufacturers:

- .1 Hubbell
- .2 Legrand
- .3 Leviton
- .4 Cooper

2.11 Boiler Shut-Off Switches

- .1 Boiler shut-off switches shall be red illuminated mushroom type, Siemens Model 35B1801.

2.12 Cover Plates

- .1 Switch, receptacle, telephone and other plates shall be stainless steel 18-8 chrome metal alloy, Type 302, non-metallic in finished areas and pressed steel in unfinished areas. Finish brush marks shall be run in a vertical direction.
- .2 Cover plates shall be of the same manufacturer throughout.
- .3 Cover plates shall be as manufactured by:
 - .1 Leviton
 - .2 Hubbell
 - .3 Legrand

2.13 Destratification Fans and Controls (Gym)

- .1 Air Pear Thermal Equalizer by AIRIUS.
- .2 Eye hook/eyebolt for free hanging.
- .3 6 foot cord for direct power connection (plug-in is not acceptable).
- .4 The Supplier or Electrical Contractor shall supply wire guards for fans.
- .5 The Supplier or Electrical Contractor shall supply a speed controller to suit the supplied fan. Speed controller to be able to control two fans. Provide stainless steel cover plate.

2.14 Disconnect Switches

- .1 Fused or Un-fused disconnect or safety switches shall be Type "A", quick-make, quick-break construction with provision for padlocking switches in either "ON" or "OFF" position.
- .2 Switches throughout job shall be of same manufacture.

- .3 Fused switches shall have fuse clips designed for Class “J” fuses and designed to reject standard N.E.C. fuses.
- .4 Switches shall be as manufactured by:
 - .1 Eaton
 - .2 Siemens
 - .3 Schneider Electric
- .5 Provide fused or un-fused safety or disconnect switches as shown and as required by Code.

2.15 Motor Starters

- .1 Starts shall conform to C.S.A. C22.2 No. 14 (latest edition) and E.E.M.A.C. E14-1.
- .2 Manual motor starters shall be/have:
 - .1 Used for motors ½ horsepower or less
 - .2 Equal to Allen Bradley type 600 and 609
 - .3 Toggle operated
 - .4 Locking
 - .5 Plug-in heaters sized to suit the full load current of the motors installed
 - .6 Red neon pilot light
- .3 Magnetic motor starters shall be/have:
 - .1 Used for motors over ½ horsepower
 - .2 Equal to Allen Bradley I.E.C. type
 - .3 Contactor solenoid operated, rapid action type
 - .4 Motor overload protective device in each phase, manually reset from outside enclosure
 - .5 Hand/off/auto push button selector switches
 - .6 Indicating lights: standard duty, 1 red pilot light for “stop” or “off” and 1 green light for “start” or “on”.
 - .7 1-N/O and 1-N/C spare auxiliary contacts
 - .8 24 volt auxiliary contacts
 - .9 Wiring and schematic diagram inside starter enclosure in visible

location

- .4 Combination starters shall be/have:
 - .1 Used where fused switch and magnetic starter are in same location
 - .2 Equal to Allen Bradley I.E.C.
 - .3 Include fused disconnect switch with operating lever on outside of enclosure to control disconnect
 - .4 Locking in "OFF" position
 - .5 Independent locking of enclosure door
 - .6 Provision for preventing switching to "ON" position while enclosure door is opened.
 - .7 Magnetic starter features as per above.
- .5 Provide control transformers and auxiliary contacts as required for control connections.
- .6 Provide push to test lights throughout.
- .7 Half size and I.E.C. starters will not be accepted.
- .8 Acceptable Manufacturers:
 - .1 Allen Bradley
 - .2 Eaton
 - .4 Siemens
 - .5 Schneider Electric

2.16 Control Transformers

- .1 Control transformers shall conform to C.S.A. C22.2 No. 66 (latest edition).
- .2 Auto-transformers shall conform to C.S.A. C22.2 No. 47 (latest edition).
- .3 Single phase, dry type, control transformer with primary voltage as indicated and secondary voltage to suit remote control device, complete with secondary fuse, installed in with starter as indicated.
- .4 Size control transformer for control circuit load plus 20 percent spare capacity.

2.17 Contactors

- .1 Contactors shall conform to C.S.A. C22.2 No. 14 (latest edition).
- .2 Electrically held and controlled by pilot devices as indicated and rated for

type of load controlled. (Mechanically held style for exterior lighting control).

- .3 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .4 Mount in C.S.A. Enclosure 1 unless otherwise indicated.
- .5 Include following options in cover:
 - .1 Red indicating lamp.
 - .2 Hand – Off – Auto selector switch.
- .6 24 volt Control transformer: mounted in contactor enclosure.
- .7 Acceptable Manufacturers:
 - .1 Allen-Bradley
 - .2 Eaton
 - .3 Siemens
 - .4 Schneider Electric

2.18 Control Relays

- .1 Control relays shall be equal to Allen Bradley type P, electrically held. Confirm coil voltages for relays controlling mechanical equipment with controls contractor.

2.19 Surface Raceway Systems

- .1 All surface mounted raceways shall be two cell compartment for power and data/voice with full separation between compartments where required.
- .2 Surface raceway is to be utilized in dry interior locations only as covered in Article 352 Part B of the National Electrical Code, as adopted by the National Fire Protection Association and as approved by the American National Standards Institute.
- .3 The surface raceway system specified herein for branch circuit wiring and/or data network, voice, video and other low-voltage wiring shall be steel system as manufactured by the Wiremold Company, V500 / V700 / 700WH Series for single devices.
- .4 The surface raceway system specified herein for branch circuit wiring and/or data network, voice, video and other low-voltage wiring shall be steel system as manufactured by the Panduit, T70 Series for multiple devices in same location as noted on drawings.
- .5 The raceway and all system components must be U.L. Listed.

- .6 The raceway shall be a one-piece design with base and cover factory assembled.
- .7 Manufacturer shall provide tools to cut, bend and install raceway.
- .8 A full compliment of fittings must be available including, but not limited to flat, internal and external elbows, tees entrance fittings, cover clips and end caps. The fittings shall have a matte texture, in ivory or white colours to match the base and cover. They shall overlap the cover and base to hide uneven cuts. All fittings shall be supplied with a base where applicable to eliminate mitreing. A transition fitting shall be available to adapt to other Wiremold series raceways.
- .9 Device brackets shall be available for mounting standard devices in-line with the raceway. Faceplates shall match and fit flush in the device plate.
- .10 The raceway manufacturer will provide a complete line of connectivity outlets and modular inserts for U.T.P. (including Category 5), S.T.P. (150 ohm) Fibre Optic, Coaxial and other cabling types with face plates and bezels to facilitate mounting. This contractor is to provide brackets for faceplates to be provided by others.
- .11 Acceptable Manufacturers:
 - .1 Wiremold Company
 - .2 Hubbell
 - .3 Panduit

2.20 Hand Dryers

- .1 Hands dryers are to be supplied and installed by this Division with the following features:
 - .1 U.L.C certified
 - .2 Low velocity
 - .3 Surface mounting
 - .4 Directional nozzle with automatic activation
 - .5 White finish
 - .6 Rating of 2300 Watts (20 Amps) at 120 volts
 - .7 Equal to World Dryer NOVA 5

2.21 Hangers and Supports

- .1 Provide and correctly locate all hangers and inserts required for the installation of all work under this Contract.

- .2 Hangers for electrical conduit shall be galvanized after fabrication.
- .3 Conduit hangers shall be as manufactured by:
 - .1 Burndy Canada Limited
 - .2 Canadian Strut Products Limited
 - .3 E. Myatt and Co. Limited
 - .4 Steel City Electric Co.
 - .5 Pilgrim
 - .6 Thomas and Betts
 - .7 B-line
- .4 Do not use perforated strapping (grappler bars).

2.22 Finishes and Painting

- .1 All factory supplied equipment shall have finish coating factory applied whether finish be painted, galvanized or other, as required and as specified.
- .2 Repair dents and touch up all damaged finishes with matching finish, or if required by the Consultant or Owner, completely repaint or replace damaged surface at no extra cost to the Contract.

Part 3 - Execution

3.1 General

- .1 All wiring to meet Ontario Electrical Safety Code and local authorities.
- .2 All power, interlock and control wiring over 50 volts, and disconnects shall be supplied and installed by the Electrical Contractor. Coordinate with Division 22 and 23.
- .3 Division 22 and 23 shall install all control and low voltage interlock wiring less 50 volts or less for mechanical equipment unless specified.
- .4 All outdoor wiring to be run in liquidtight. All indoor wiring to be run in conduit. Last 1.5 meters (5 feet) at final connection to equipment shall be run in flexible conduit only (not liquidtight).
- .5 Where wire size is not indicated, ampacity must match or exceed rating of protective device.
- .6 Panels are specified as sequence bussed and all branch circuit wiring from these panels shall be such that where a common neutral is used for two or three circuits, these circuits shall be fed from adjacent breakers, so

- that single-pole breakers may be replaced with 2 or 3 pole breakers should this be required in the future. All circuits shall be balanced. All neutrals shall be sized to meet the requirements of Section 4-018 of the Ontario Electrical Safety code and in no case smaller than 12 A.W.G.
- .7 Feeders, sub-feeders, circuit wiring and ancillary items shall be colour coded for phase identification. Neutral conductors shall be full capacity with white covering and be continuous throughout the system without fuses, switches or breakers of any kind.
 - .8 Install wiring continuously within raceways, splices will be permitted only at outlets and junction boxes. Sufficient slack wire shall be left at these points to permit proper connection of fixtures, devices, equipment, etc.
 - .9 Any exposed conduits or cables shall be run parallel to or at right angles to building lines and in a neat manner. Conduits shall be thoroughly reamed and each threaded termination shall be provided with two lock nuts. Running threads for rigid conduit will not be accepted.
 - .10 Internal raceways in the building
 - .1 Securely cap or plug all openings in conduit and ducts during the execution of the Work to prevent dust and debris from entering the openings.
 - .2 At completion of the installation, the service entry ducts and the conduit system in the building shall be fished to clear all blocks.
 - .11 Outlet and pull boxes shall be cleaned out and the system left free from water and moisture.
 - .12 Provide all conduit, wire, fittings, disconnect switches, line voltage, starters, disconnects, controls and auxiliary materials as previously defined to wire into service all 3 phase motors, single phase motors and equipment included in other Sections unless specified otherwise.
 - .13 Install pull boxes in conduit run where required to facilitate the pulling in of cable and locate in inconspicuous accessible spaces.
 - .14 Provide flexible connections to mechanical equipment for vibration isolation. Connections to equipment roof mounted or in other damp or wet locations shall be liquid tight.
 - .15 Conduits and cables shall not be attached to mechanical units for support.
 - .16 All devices in General Purpose rooms (Gym), Mechanical and/or Electrical rooms and all exterior mounted devices shall have wire guards for protection from mechanical damage. Provide wire guards elsewhere as noted on drawings.

3.2 Wiring Methods

- .1 Install wiring in conduit unless otherwise specified.
- .2 Flexible conduit and armoured cable will be accepted for a maximum length of 1500 millimeters for final connection to lighting fixtures. Do not connect from fixture to fixture.
- .3 Use thin wall conduit (E.M.T.), up to and including 53 millimeters conduit size, for branch circuit and feeder wiring in ceilings, furred spaces, concrete block walls, hollow walls and partitions. Use rigid galvanized steel conduit for wiring in poured concrete, where exposed, and for conduit 65 millimeters or larger. Use rigid P.V.C. conduit for wiring in slabs on grade and wiring below grade.
- .4 Aluminum conduit may be used, in lieu of rigid steel conduit, in clean and dry locations, but shall not be used in poured concrete, or for signal and intercommunication systems wiring.
- .5 Conduit manufacturer's touch-up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.

3.3 Outlet Boxes

- .1 Where 103 millimeters square outlet boxes are installed in exposed concrete or cinder block finished areas, blocks will be cut under Masonry Division as instructed under this Section. Opening shall be cut to provide a close fit to boxes and covers so that edges of openings are not visible after installation of plates. Mortar shall not be used to patch up openings that are cut too large or to patch ragged edges.
- .2 Ceiling boxes shall be 103 millimeters octagon or square, complete with fittings, where required to support fixtures.
- .3 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area it is to be installed.
- .4 Support outlet boxes independently of conduit and cable.
- .5 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.
- .6 Offset outlet boxes, shown back to back in partitions, horizontally a min. 150 millimeters to minimize noise transmission between adjacent rooms.
- .7 Use gang boxes at locations where more than one device, of the same system only, is to be mounted. Each system shall utilize separate boxes.
- .8 Use tile wall covers where 103 millimeters square outlet boxes are installed in exposed concrete or cinder block in finished areas.
- .9 Flush mount boxes, panels, cabinets and electrical devices, which are installed in finished areas, shall be provided with suitable flush trims and

doors or covers, unless specifically noted otherwise.

- .10 Provide pre-formed polyethylene vapour barriers for all boxes located in walls with internal vapour barriers.

3.5 Conduit Accessories, Condulets and Fittings

- .1 Terminate rigid conduit entering boxes or enclosures with nylon insulated steel threaded bushings.
 - .1 Thomas and Betts – 8125 Series
- .2 Terminate E.M.T. entering boxes or enclosures with nylon insulated steel threaded bushings.
- .3 Terminate flexible conduit entering boxes or enclosures with nylon insulated steel connectors.
 - .1 Thomas and Betts – 5332 Series
- .4 Install wall entrance seals where conduits pass through exterior walls below grade.
- .5 Provide expansion coupling in conduit runs at building expansion joints and in long runs subject to thermal expansion, all in accordance with manufacturer recommendations.

3.6 Conductors, Wires and Cables

- .1 Conductors shall be colour coded. Conductors No. 10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No. 8 gauge and larger may be colour coded with adhesive colour coding tape but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible.
- .2 Colour Coding shall be as follows:
 - .1 Phase “A” – Red
 - .2 Phase “B” – Black
 - .3 Phase “C” – Blue
 - .4 Control – Orange
 - .5 Ground – Green
 - .6 Neutral – White
- .3 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

- .4 Splice wire, up to and including No. 6 gauge, with nylon insulated expandable spring type connectors.
 - .1 Thomas and Betts – Marr Max Series
 - .5 Splice large conductors using compression type connections insulated with heat shrink sleeves.
 - .1 Thomas and Betts – 5400 Series lugs and heat shrink type #s series
 - .6 Where colour coding tape is utilized, it shall be applied for a minimum of 2 inches at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition. Colour coding shall also apply to bussing in panels and, switchgear, disconnects, and metering cabinets.
- 3.7 Splitters
- .1 Install splitters and mount plumb, true and square to the building lines on 19 millimeters (3/4 inches) painted plywood backboards.
 - .2 Provide equipment identification in conformance with Section 260501.
- 3.8 Junction Boxes and Pull Boxes
- .1 Install pull boxes in inconspicuous but accessible locations. Provide access doors in all drywall areas.
 - .2 Install junction boxes and pull boxes so as not to exceed 30 meters (100 feet) of conduit run between pull boxes and in conformance with the Electrical Safety Authority.
 - .3 Provide equipment identification in conformance with Section 260501.
 - .4 Label all junction boxes with panel and circuit number.
- 3.9 Switches
- .1 Install single throw switches with handle in the “up” position when switch is closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Confirm colour prior to ordering.
 - .4 Refer to Section 26 05 01 for mounting heights.
- 3.10 Receptacle
- .1 Mount receptacles so long dimension is in the vertical.
 - .2 Exact locations shall be verified to suit furniture layout.
 - .3 Connect receptacle grounding terminal to the outlet box with a copper

wire.

- .4 Install receptacles in gang type outlet box when more than one switch is required in one location.
- .5 Where split receptacle has one portion switched mount vertically and switch upper portion.
- .6 Weatherproof receptacles shall be equal to 20 amps G.F.I. and mounted in weatherproof enclosure complete. Enclosure shall be equivalent to Hubbell RW58300.
- .7 Confirm colour prior to ordering.
- .8 Refer to Section 26 05 01 for mounting heights.

3.11 Cover Plates

- .1 Do not install plates until final painting of room or area is completed. Remove protective covering.

3.12 Destratification Fans and Controls

- .1 Ensure fans and controls are installed in conformance with manufacturer recommendations.
- .2 Suspend/free hang ceiling fans from roof structure from eye hook / eyebolt on fan. Use minimum ¼ carabineer. Provide chain for back-up support.
- .3 Provide junction box for power connection directly above the fan and run flexible conduit to fan.
- .4 Fans shall be mounted level with surrounding structure to ensure air flow is not impeded.
- .5 Electrical Contractor shall supply and install switch or speed controller to suit fan.
- .6 Install wire guards to be level. Fasten wireguards to structure NOT roof deck. Provide intermediate unistrut supports to suit.
- .7 Demonstrate fan operation at the time of final inspection.

3.13 Surface Raceway Systems

- .1 Raceway is to be supplied and installed with all necessary fittings, hardware and device brackets for a complete functional system
- .2 Install conduit system, wiring and devices as indicated.
- .3 Install raceway as per manufacturer recommendations.
- .4 Provide end caps where raceway ends.

3.14 Hangers and Supports

- .1 Provide and correctly locate all hangers and inserts required for the installation of all work under this Contract.
- .2 Support outlet boxes, junction boxes, conduit and all electrical equipment independently with hangers and fastenings to building structural members.
- .3 Hangers in general shall be supported from inserts in concrete construction or from building structure using beam clamps for steel structures. Provide all additional angle or channel steel members required between beams for support of conduits, cables, luminaires, etcetera.
- .4 Use coach screws, lag screws or wood screws as appropriate in any wood construction.
- .5 Feeders, conduits and power ducts running vertically in a building shall be supported at each floor and between each floor if necessary.

3.15 Mounting Heights

- .1 Refer to Section 26 05 01.

3.16 Conduit Sleeves and Curbs

- .1 Provide conduit sleeves of galvanized steel for conduit and cable runs passing through concrete walls, beams, slabs and floor. Include for all power, communications and control wiring. All conduit sleeves shall be deburred and have plastic bushings installed to protect wiring.
- .2 Extend galvanized conduit sleeves for conduit rising through slabs 4 inches minimum above finished floors. Provide sleeves, passing through floors having a waterproof membrane, with an integral flashing clamp.

3.17 Hand Dryers

- .1 Install and connect hand dryers in conformance with manufacturer's recommendations.
- .2 Provide G.F.I. breaker for circuit feeding hand dryer.
- .3 Hand dryers are to be mounted at a height to suit age of expected users. Unless otherwise noted confirm height with Architectural drawings prior to rough in.
- .4 Once installed this Contractor is to caulk the joint between dryer and wall surface with a bead of white silicone. Coordinate installation with General Contractor.

3.18 Supports and Bases

- .1 Mount Switchboards, Motor Control Centres and all other floor mounted

electrical equipment on chamfered edge housekeeping pads, minimum of 100 millimeters (4 inches) high and 150 millimeters (6 inches) larger than equipment dimensions all around.

- .2 Supply and erect special structural work required for installation of electrical equipment. Provide anchor bolts and other fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.
- .3 Switches or other electrical equipment shall be complete with suitable bases or mounting brackets.
4. Provide channel or other metal supports where necessary, to adequately support lighting fixtures. Do not use wood unless wood forms part of the building structure.
5. Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members, required between beams for supporting conduits and cables.
6. Provide any additional supports required from existing concrete construction for any piping or equipment, by drilling same and installing expansion bolt cinch anchors.
7. Do not use explosive drive pins in any section of work without obtaining prior approval.

3.19 Finishes and Painting

- .1 Primary and final painting for work, other than items specified as factory primed or finished, shall be performed by trades specializing in this type of work.
- .2 Repair and finish factory finished equipment, damaged or scratched during installation, in an approved manner.
- .3 Leave bare metal surfaces ready for painting by removing dirt, rust, grease or millscale to Consultant's approval.
- .4 All structural steel including hangers, brackets, supports and other ferrous metals shall be shop or factory prime painted wherever practicable. Wherever structural steel including hangers, brackets, supports, and other ferrous metals cannot be shop or factory prime painted, wire brush to remove all traces of rust, clean of all traces of dirt, oil, and grease, and apply one coat of an approved rust inhibiting primer in accordance with C.G.S.B.-G.B.-40d and leave ready to receive finish paint.

3.20 Electrical Connections for Mechanical Equipment

- .1 Provide all required electrical connections to apparatus provided and/or supplied by Division 21, 22 and 23, the Owner and as part of the work of other Divisions of the Specifications.
- .2 All power and control wiring over 50 volts and disconnects shall be installed by the Electrical Contractor.
- .3 All control and low voltage wiring 50 volts and under shall be installed by the Mechanical Contractor and/or Controls Contractor. Coordinate all low voltage wiring with the Mechanical Contractor.
- .4 All connections to roof mounted mechanical equipment shall be installed through a gooseneck style pitch pocket equal to Thaler Metal MEF-2A/2A1/2A2. Pitch pocket supplied and installed by Electrical Contractor. Coordinate installation with General Contractor and/or Roofing Contractor.

3.21 Motors and Starters

- .1 Division 26 shall supply and install all starters unless otherwise indicated.
- .2 Coordinate with Division 22 and 23 as required.
- .3 Install line voltage disconnect switches at each motor not within the required distance from its starter to meet code requirements.
- .4 All motors shall be wired and connected under this Division. The drawings do not necessarily show the exact location of wiring to motors and it shall be the responsibility of this Division to fully coordinate this work with Division 22 and 23.
- .5 Temperature Controls: Be responsible for the "line" side power connections to all control apparatus where detailed or required to make the system operational.

3.22 Equipment Identification

- .1 Refer to Section 26 05 01.

3.23 Testing

- .1 Make tests of equipment and wiring at times requested.
- .2 Tests shall include meggered insulation values, voltage and current readings to determine balance of panels and feeders under full load, and operation of each piece of equipment for correct operation.
- .3 Supply meters, materials and personnel as required to carry out these tests.
- .4 Test electrical work to standards and function of Specification and

applicable codes in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.

- .5 Before energizing system, check all connections and set and calibrate all relays and instruments for proper operation, obtain necessary clearances, approval and instructions from utility company.
- .6 Connect single phase loads so that there is the least possible unbalance of the supply phases.
- .7 Submit all test results in report format.

End of Section

Part 1 - General

1.1 Shop Drawings

- .1 Submit shop drawings for each system in Conformance with Section 26 05 01.

1.2 Product/Maintenance Data

- .1 Submit product/maintenance data for each system for inclusion in maintenance manual conforming to Section 26 05 01.

1.3 Scope

- .1 The scope of this Section will include the following systems.
 - .1 Cable management system
 - .2 Telephone system rough-in
 - .3 Communications rough-in
 - .4 Fire Assembly

Part 2 - Products

2.1 Cable Management System

- .1 The system where noted shall be a continuous, rigid, welded steel wire mesh cable management system with the following features:
 - .1 Permits continuous ventilation of cable and maximum dissipation of heat.
 - .2 Continuous safety edge T-welded wire lip.
 - .3 Welded at all intersections.
 - .4 Straight sections 4 inches by 12 inches (100 millimeters by 300 millimeters) in configurations noted on the drawings.
 - .5 Constructed of carbon steel wire, A.S.T.M. A 510, grade 1008. Wire welded, bent, and surface treated after manufacture.
 - .6 Post fabrication finish of electro-plated zinc galvanizing: A.S.T.M. B 633, Type III, S.C.-1.
 - .7 Fittings: Field fabrication in accordance with manufacturer's instructions from straight sections.
- .2 The support system shall be threaded rods as per manufacturer recommendations for specified system

- .3 The necessary hardware, including splice connectors and support components furnished by manufacturer.
- .4 The product shall be W.B.T. tray. WBT 4 by 8 complete with support brackets and hangers at intervals as recommended by the manufacturer.
- .5 The manufacturer shall be: W.B.T.

2.2 Telephone System Rough-In

- .1 Provide a #6 insulated green ground conductor from main service ground to telephone equipment backboard located on drawings.
- .2 Outlets where noted shall be single gang flush mounted in wall.
- .3 Recess empty conduit
- .4 Outlets if unwired are to be provided with blank cover plates

2.4 Communications Rough-In

- .1 Concealed empty conduit with pull strings and junction boxes maximum 50 foot spacing.
- .2 Outlets where noted shall be single gang flush mounted in wall.
- .3 Recess empty conduit
- .4 Outlets if unwired are to be provided with blank cover plates.

2.4 Fire Assembly

- .1 Provide fire rated assembly for communication cables entering any data rooms as noted on drawings.
- .2 Fire Assembly shall be Specified Technologies Inc. model #EZDP433GK.

Part 3 – Execution

3.1 Cable Management System

- .1 Install cable management system at locations indicated on the drawings and in accordance with manufacturer's instructions.
- .2 Support system every 2.4 meters (8 feet - 0 inches) unless system is used within a telecommunication room. In that situation support every 1.5 meters (5 feet – 0 inches).
- .3 Cute wires in accordance with manufacturer's instructions.
- .4 Cut wires with side action bolt cutters to ensure integrity of galvanic protective layer. Cut using side action bolt cutters.
- .5 Cut each wire with 1 clean cut to eliminate grinding or touch-up.

- .6 Install cable management system using hardware, splice connectors, support components, and accessories furnished by manufacturer.
- .7 Suspend from structure or intermediate unistrut channel spanning across the corridor where access to structure is not available due to the concentration of mechanical ductwork and/or piping.
- .8 Ground cable tray with continuous ground per O.E.S.C. and manufacturer instructions. Test to ensure minimum 5 ohms resistance.
- .9 Locate cable management system minimum 9" EMI source including but not limited to fluorescent lights, transformers, motors, and power cables.
- .10 Coordinate installation with communications contractor prior to ordering final system to ensure communication requirements are met.

3.2 Telephone System Rough-In

- .1 Installed incoming service duct and terminated as noted.
- .2 Provide background as noted complete with ground connection to main service ground.

3.5 Communications Rough-In

- .1 Outlets are to be installed complete with 21 millimeters ($\frac{3}{4}$ inches) conduit to ceiling space or nearest zone conduit (if applicable).
- .2 Provide insulated bushings on all conduits terminated in ceiling space.

End of Section

Part 1 - Generak

1.1 General Requirements

- .1 The studies must be submitted to the Consultant prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Consultant may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device rating and characteristics will be satisfactory.
- .2 The studies shall include all portions off the electrical distribution system from the normal power source or source down to and including the smallest adjustable trip circuit breaker in the distribution system. Normal system connections and those, which result in maximum fault conditions, shall be adequately covered in the study.
- .3 The firm should be currently involved in high- and low- voltage power system evaluation. The study must be performed, stamped and signed by a registered professional engineer in the Province of Ontario. Credentials of the individual(s) performing the study and background of the firm shall be submitted to the Consultant for approval prior to start of the work. A minimum of five (5) years experience in power system analysis is required for the individual in charge of the project.
- .4 The firm performing the study should demonstrate capability and experience to provide assistance during start up as required.

1.2 Data Collection For The Study

- .1 The Contractor shall provide the required data for preparation of the studies. The Consultant performing the system studies shall furnish the Contractor with a listing of the required data immediately after awards of the contract.
- .2 The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacturing.

Part 2 - Products

2.1 Short Circuit And Protective Device Evaluation And Coordination Study

- .1 The short-circuit study shall be performed with the aid of a digital computer program and shall be in accordance with the latest applicable I.E.E.E. and A.N.S.I. standard.

- .2 In the short-circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculation, tabulations of calculation quantities and results, conclusions, and recommendations. Calculate short-circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low-voltage switchgear lineup, switchboard, motor control centre, distribution panelboard, pertinent branch circuit panelboard, and other significant overcurrent protective device locations throughout the system. Provide a ground fault current study for the same system area, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor fault contribution, short circuit k.V.A., and symmetrical and asymmetrical fault currents.
- .3 In the protective devices coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time, dial, pickup, instantaneous, and time delay settings.
- .4 Include on the curve sheets power company relay and fuse characteristics, medium-voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. In addition, include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control centre, and main breaker in branch panelboards.

Include all adjustable setting for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical fault currents. Terminate device characteristics curves at a point reflecting the maximum symmetrical fault current to which the device is exposed.
- .5 Select each primary protective device required for a delta-wye connected transformer so that it's characteristic or operating band is within the transformer characteristic, including a point equal to 58 percent of the A.N.S.I. withstand point to provide secondary line-to-ground fault protection. Separate transformer primary protective by a 16 percent current margin to provide proper coordination and protection in the event

- of secondary line-to-line faults. Separate medium-voltage relay characteristics curves from curves for other devices by least a 0.4- second time margin.
- .6 Include complete fault calculations as specified herein based on contract documents.
- .7 Submit qualifications of individuals(s) who will perform the work for approval prior to commencement of the studies. Provide studies in conjunction with equipment submittals to verify equipment ratings required. Submit the study to Consultant for review prior to delivery of the study to the Owner. Make all additions or changes as required by the reviewer.
- .8 Utilize equipment load data for the study obtained by the Contractors from contract document, including contract addendum's issued prior to bid openings.
- .9 Include fault contribution of all motors in the study. Notify the consultant in writing of circuit protective devices not properly rated for fault conditions.
- .10 When emergency generator is provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristics of the protective devices. Contractor shall obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not typical values for the generator.
- .11 Evaluate proper operations of the ground relays in 4-wire distributions with more than one main service circuit breaker, or when generators are provided, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault.
- .12 For motor controls circuits, show the M.C.C. full-load current plus symmetrical and asymmetrical of the largest motor starting current and time to ensure protective devices will no trip during major or ground start operation.

2.2 Arc Flash Hazard Analysis

- .1 The contractor shall furnish an Arc Flash Hazard Analysis Study per N.F.P.A. 70E- Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D. and C.S.A. Z462-2018.
- .2 The arc flash hazard analysis shall be performed according to the I.E.E.E. 1584 equations that are presented in N.F.P.A.70E-2018, Annex D.

- .3 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study room. Alternative methods shall be presented in proposal.
- .4 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboard, busway and splitters) where work could be performed on energized parts.
- .5 The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 k.V.A..
- .6 Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal. per square centimeter.
- .7 The Arc Flash Hazard analysis shall include calculation for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- .8 Arc flash computation shall include both line and load side of main breaker calculations, where necessary.
- .9 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped based on I.E.E.E. 1584 latest edition.

2.3 Study Report

- .1 The result of the power system study shall be summarized in a final report. Three (3) bound copies of the copies of the final report must be submitted.
- .2 The report shall include the following sections:
 - .1 Descriptions, purpose, basis, and scope of the study.
 - .2 Tabulation of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
 - .3 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

- .4 Fault current calculations including a definition of terms and guide for interpretation of computer printout.
- .5 Incident energy and flash protective boundary calculations
 - .1 Arcing fault magnitude
 - .2 Device clearing time
 - .3 Duration of arc
 - .4 Arc flash boundary
 - .5 Working distance
 - .6 Incident energy
 - .7 Hazard Risk Category
 - .8 Recommendations for flash energy reduction

Part 3 – Execution

3.1 Field Settings

- .1 The Contractor shall perform field adjustment of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study, and protective device coordination study.
- .2 Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short-circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the Owner.

3.2 Arc Flash Warning Labels

- .1 The vendor shall provide a 3.5 inch by 5 inch thermal transfer type label of high adhesion polyester for each work location analyzed.
- .2 The label shall have an orange header with the wording, “WARNING , ARC FLASH HAZARD” and shall include the following information:
 - .1 Location designation
 - .2 Nominal voltage
 - .3 Flash protection boundary
 - .4 Hazard risk category
 - .5 Incident energy

- .6 Working distance
- .7 Engineering report number, revision number and issue date.
- .3 Labels shall be machine printed, with no field marking.
- .4 Arc flash labels shall be provided in the following manner and all labels shall be based on recommend overcurrent device settings.
 - .1 For each 600, 480 and applicable 208 volt panelboard, one arc flash label shall be provided.
 - .2 For each motor control centre, one arc flash label shall be provided.
 - .3 For each low voltage switchboard, one arc flash label shall be provided.
 - .4 For each switchgear, one flash label shall be provided.
 - .5 For medium voltage switches one arc flash label shall be provided.
- .5 Labels shall be field installed by the firm providing the Arc Flashing Hazard Analysis

3.3 Acceptable Testing Firms

- .1 MVA Engineering
- .2 G.T. Woods
- .3 Brosz and Associates
- .4 K-Tek Electro-services Limited
- .5 Eaton Electrical Service Group
- .6 Schneider Electrical Service Group
- .7 Siemens Service Group

End of Section

Part 1 - General

1.1 Codes and Standards

- .1 Ontario Electrical Safety Code-Current Edition
- .2 C.S.A.
- .3 U.L.C.
- .4 Local Codes and Requirements

1.2 Submittals

- .1 Shop Drawings:
 - .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
 - .2 Shop drawings shall include manufacturer, model numbers, electrical data, wiring diagrams, and indicate conformance to above reference standards.
 - .3 One copy of all stamped approved shop drawings shall be included in maintenance manual.
- .2 Operation and Maintenance Data:
 - .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
 - .2 Operation and maintenance data shall be included in the maintenance manual.

Part 2 – Products

2.1 Duct (direct buried underground cable duct)

- .1 P.V.C. ducts and fittings: Rigid P.V.C. duct to C.S.A. C22.2 No. 211.1, type DB2 with fittings for direct burial (expanded flange ends).
- .2 Rigid P.V.C. bends, reducers, bell end fittings, plugs caps, spacers, adaptors same product material as duct to make complete installation
- .3 Cable: C.U. RWU75 XLPE of size noted on drawings. Cable termination temperature to be adjusted to suit equipment to be installed.
- .4 Cable termination: cable termination of sufficient length to connect to secondary of pad mounted transformer and neutral. Coordinate with Utility (Hydro One).

2.2 Service Entrance Rated Disconnect

- .1 Provide 400 amp 600 volt service entrance rated fusible disconnect complete fuses with interrupting capacity as noted on drawings.
- .2 Provide a nametag on the exterior of the enclosure. Nametag to indicate interrupting rating, voltage, service description, etcetera.
- .3 Acceptable Manufacturers:
 - .1 Eaton
 - .2 Schneider
 - .3 Siemens

2.3 Hydro Metering

- .1 Provide 4 feet by 4 feet meter cabinet enclosure for metering equipment.
- .2 Provide 1-1/4 inches conduit from switchboard C.T. compartment to meter cabinet.
- .3 Coordinate with local Utility as required.

2.4 Lighting and Receptacle Panels

- .1 Panel boards shall be as manufactured by Eatons complete with circuit breakers and labeled with a C.S.A. short circuit rating. Panel board and circuit breaker short circuit rating shall be as indicated on panel schedules. Provide copper bus sized in accordance with the contract drawings and C.S.A. standards.
- .2 Electrical characteristics, main sizes, quantities of breakers and quantity of branch circuits shall be as indicated on the drawings.
- .3 Where noted on the drawings, panel boards serving isolated ground circuits shall be complete with a separate ground bar isolated from the panel board box by an insulating plate. Connect this ground bar directly to the main building ground using AWG #6 copper minimum or larger as required by table 16 of the Ontario Electrical safety Code (unless otherwise noted).
- .4 Panel boards shall be supplied with doors, concealed hinges, chromed locks and hardware. All locks shall be keyed alike. Doors shall be fitted with plastic covered panel directory, with circuits and areas served typed in. Doors shall be provided with spring latches and semi flush cylinder locks and catch assemblies. Provide two (2) keys per panel board.
- .5 All panel boards to have sprinkler proof enclosures.
- .6 Branch Breakers: Shall be of the heavy duty, bolt-on type, single, two or three pole as shown on the drawings and of the ampere ratings indicated. They shall be thermal magnetic, non interchangeable, moulded, case type

- with toggle mechanism, and be designed for use as switches. Two and three pole breakers shall be common trip type with single handle. Handle ties will not be permitted. Each breaker to be quick-make, quick break type. Shall be approved for use with C.U./A.L. cables.
- .7 Breakers 200 Amps and above shall have adjustable long delay pickup/time, adjustable short delay pickup/time and adjustable instantaneous pickup.
 - .8 Provide lock-on devices for fire alarm, stairway, exit and night light circuits.
 - .9 Ground fault circuit interrupters where required shall be C.S.A Class A. with 5 m.A. tripping level and shall have push-to-test button on front.
 - .10 Provide ground bus in each panel.
 - .11 Door and trim finish: grey enamel.
 - .12 Panel board depth is not to exceed 146 millimeters.
 - .13 Cover plates shall be provided for all the blank spaces in the distribution section.
 - .14 Provide a nametag on the exterior of the enclosure. Nametag to indicate interrupting rating, voltage, service description, etcetera.
 - .15 Provide sequential phase bussing with odd numbered breakers on the left and even numbered on the right complete with each breaker identified by permanent marker identification as to circuit number and place.
 - .16 Main breaker, where required, to be mounted top or bottom of the panel to suit cable entry. When mounted vertically, down position shall trip the breaker.
 - .17 Branch circuit panel boards (250 Amp or smaller) must be equal to Eatons POW-R-Line-C PRL-1 or PRL-2 or approved alternate.
 - .18 Branch circuit panel boards shall be complete with transient voltage surge suppression filtering system integral to the panel tub and must be equal to Eatons #CPSBXCH208YSD or approved alternate.
 - .19 Power distribution circuit breaker panel boards (400 Amp or larger) must be equal to Eatons POW-R-Line-C PRL-4a with bottom side entry wire way or approved alternate.
 - .20 Acceptable Manufacturers:
 - .1 Eaton
 - .2 Schneider
 - .3 Siemens

2.6 Fuses

- .1 Fuses: Shall be RK5 or HRC-I, Class J or L unless otherwise specified. Fuses in combination starters shall be HRC time delay type where specified.
- .2 Motor fuses shall be sized according to the Drawings for the specified motor and starting cycle.
- .3 Fuses shall be as manufactured by Buss, Gould, Little Fuse or approved equal.
- .4 Provide three spare fuses of each type and size installed for maintenance.

Part 3 – Execution

3.1 Installation of Service Conduits and Cables

- .1 Run service entrance conduits as shown on the site plan and the trench section for primary and secondary duct bank.
- .2 Supply and install CU RWU75 XLPE of size noted on drawings from secondary of pad mount transformer to service entrance switchboard located in the electrical room. Coordinate with Utility (Hydro One) for all final terminations.
- .3 Final termination of primary cable to high voltage service and to transformer to be completed by Utility (Hydro One).
- .4 Coordinate exact locations and installation with general contractor before installation commences.
- .5 Do not pull spliced cable inside the duct.
- .6 Install multiple conductors in duct simultaneously.
- .7 Use C.S.A. approved lubricants to reduce pulling tension.
- .8 Perform insulation resistant test using a megger on each phase conductor before terminating installed cable.
- .9 Provide any test(s) as required by Utility (Hydro One).

3.2 Grounding

- .1 Provide ground plate or two ground rods and connect to the service with 3/0 copper bare ground wire.
- .2 Make all required ground connections from water meter and gas piping to main electrical service ground. Ground conductors shall be minimum #2/0 copper wire connected with approved fittings.

- .3 Conduit systems shall not be used for grounding. Provide separate ground conductors in all raceways. Bond the ground wire to all boxes and luminaries.
- .4 Install grounding connections to typical equipment included in but not necessarily limited to the following list. Service equipment transformers, switchgear, duct systems, frames of motors, motor control centres, starters control panels, building steel work, distribution panels, outdoor lighting.
- .5 Test the resistance of the grounding system. Add additional ground wires and ground rods if required as directed by the Engineers and retest. Repeat this process until ground resistance is 2 ohms or less. Conduct all tests using Megger Null Balance or Megger Universal ground resistance test equipment.
- .6 Test and log all ground connections at panels, switchboards and ground buses prior to and after the computer is put into operation. Trace and isolate all equipment causing current in ground wires to exceed one ampere. Replace such equipment if furnished as part of this contract.
- .7 Test all receptacles for proper connections with a neon lamp type polarity tester. Check that ground resistance is less than 0.2 ohms with an Edgecumbe Peebles Limited, ground loop impedance tester.

3.3 Electrical Connections for Mechanical Equipment

- .1 Provide all required electrical connections to apparatus provided and/or supplied by Division 21, 22 and 23, the Owner and as part of the work of other Divisions of the Specifications.
- .2 All power and control wiring over 50 volts and disconnects shall be installed by the Electrical Contractor.
- .3 All control and low voltage wiring 50 volts and under shall be installed by the Mechanical Contractor or Controls Contractor. Coordinate all low voltage wiring with same.

End of Section

Part 1 – General

1.1 Scope

- .1 Provide complete factory assembled natural gas generator set equipment with digital electronic controls.
- .2 Provide factory test, startup by a supplier authorized by the manufacturer, and on-site testing of the system.
- .3 Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.

1.2 Codes and Standards

- .1 The generator set installation and on-site testing shall conform to the requirements of the following codes and standards, as applicable. The generator set shall include necessary features to meet the requirements of these standards.
 1. C.S.A. 282, 2015 Emergency Electrical Power Supply for Buildings
 2. I.E.E.E.446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
 3. N.F.P.A.37 – Standard for Installation and Use of Stationary Combustion Engines and Gas Turbines
 4. N.F.P.A.70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
- .2 The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.
- .3 The generator set and supplied accessories shall meet the requirements of the following standards:
 1. N.E.M.A. MG1-1998 part 32. Alternator shall comply with the requirements of this standard.
 2. U.L. 142 – Sub-base Tanks
 3. U.L. 1236 – Battery Chargers U.L. 2200. The generator set shall be listed to U.L. 2200 or submit to an independent third party certification process to verify compliance as installed.
- .4 The control system for the generator set shall comply with the following requirements.

1. C.S.A. C.22.2, Number 14 – M91 Industrial Control Equipment.
 2. E.N. 50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.
 3. E.N. 55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
 4. F.C.C. Part 15, Subpart B.
 5. I.E.C. 8528 part 4. Control Systems for Generator Sets
 6. I.E.C. Standard 801.2, 801.3, and 801.5 for susceptibility, conducted and radiated electromagnetic emissions.
 7. U.L. 508. The entire control system of the generator set shall be U.L. 508 listed and labeled.
 8. U.L. 1236/C.S.A. –Battery Chargers.
- .5 The generator set manufacturer shall be certified to I.S.O. 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with I.S.O. 9001.

1.3 Shop Drawings

- .1 Shop Drawings for Generator Set shall include:
- .1 Engine: make and model, with performance curves, and British standard or D.I.N. rating.
 - .2 Alternator: make and model, ratings and reactance data.
 - .3 Voltage regulator: make, model and type.
 - .4 Battery: make, type and capacity.
 - .5 Battery Charger: make, type and model.
 - .6 Genset Control Panel: Complete description of its functions and features, schematic details, make and type of meters and controls.
 - .7 Governor type, model.
 - .8 Cooling air and combustion air requirements in liters per second (c.f.m.).
 - .9 Maximum pressure drop for cooling fan.
 - .10 System components.

- .11 Weatherproof enclosure including sound data. Enclosure sound data will be assessed by the Engineer's Environmental Consultant to ensure it will be sufficient for this Site prior to final acceptance.
 - .12 Performance curve and prototype certificate.
 - .13 Transfer Switch
- .2 Provide a dimensioned drawing showing complete generating set mounted on steel base, including vibration isolators, exhaust system, drip trays, and total weight.
 - .3 Dimensions and structural specifications of engine-generator foundation.
 - .4 Continuous full load output of set at 0.8 power factor.
 - .5 Fuel type and consumption.
 - .6 Generator thermal damage curve and protection curves.
- 1.4 Operation and Maintenance Data
- .1 Incorporate all final reviewed shop drawings into Operation and Maintenance manual.
 - .2 Include instructions for particular unit supplied and not general description of units manufactured by supplier.
 - .3 Include operation and maintenance instructions for generator and accessories, and the following technical data:
 - .1 Illustrated parts lists with parts catalogue numbers
 - .2 Schematic diagram of electrical controls
 - .3 Flow diagrams for fuel system, lubricating oil and cooling system
 - .4 Certified copy of factory test results
 - .5 Copy of maintenance log and documentation manual
- 1.5 Engine Generator Set
- .1 The generator set shall be for standby power use.
 - .2 The prime power rated output is the output available with varying load for an unlimited time.
 - .3 The generator set shall be designed for a single step load pickup of 100 percent nameplate kilowatt and power factor.
 - .4 M.O.E. Table 1 Data Form has been completed by the Consultant and is included in Appendix 'A'.

- .5 M.O.E. Table 2 Data Form is to be completed by the Gen Set Supplier and submitted with their individual bid. A blank form has been included in Appendix 'A'.

1.6 Acceptable Manufacturers

- .1 Generac
- .2 Cummins
- .3 Toromont
- .4 Kohler
- .5 Caterpillar
- .6 Alternate as approved through addenda by consultant
- .7 The specification must be fully complied with. Any deviation/exception must be listed in the bid as non-compliance and the installing contractor will be responsible for any additional cost associated with design change/review due to non-compliance to the specification.

Part 2 - Products

2.1 Generator Set

- .1 The Generator Set shall be equal to Generac SG300 with a level 2 weather proof and sound attenuated enclosure.
- .2 Ratings
 - 1. The generator set shall operate at 1800 r.p.m. and at a voltage of 600 volts A.C., three phase, 60 hertz
 - 2. The generator set shall be rated at 300 kilowatt at 0.8 PF Standby ratings, based on site conditions of ambient temperatures up to 40 degrees Celsius.
 - 3. The generator set rating shall be based on standby service.

2.2 Performance

- .1 Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load for both parallel and non-parallel applications. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
- .2 Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25 percent.
- .3 The engine-generator set shall be capable of single step load pick up of

100 percent nameplate kilowatt and power factor, less applicable derating factors, with the engine-generator set at operating temperature.

- .4 Motor starting capability shall be a minimum of 100 kilovolt-ampere. The generator set shall be capable of sustaining a minimum of 90 percent of rated no load voltage with the specified kilovolt-ampere load at near zero power factor applied to the generator set.
- .5 The alternator shall produce a clean A.C. voltage waveform, with not more than five percent total harmonic distortion at full linear load, when measured from line to neutral, and with not more than three percent in any single harmonic. Telephone influence factor shall be less than 40.

2.3 Construction

- .1 The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.
- .2 All switches, lamps, and meters in the control system shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

2.4 Connections

- .1 The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
- .2 Power connections to auxiliary devices shall be made at the devices, with required protection located at a wall-mounted common distribution panel.
- .3 Generator set control interfaces to other system components shall be made on a common, permanently labeled terminal block assembly.

2.5 Engine and Engine Equipment

- .1 The engine shall be Natural gas fueled, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Engine accessories and features shall include:
- .2 Complete engine fuel system, including all pressure regulators, strainers, and control valves. The fuel system shall be plumbed to the generator set skid for ease of site connections to the generator set. For dual fuel systems, changeover from primary to secondary fuel shall be automatic.

- .3 An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous or parallel states.
- .4 Skid-mounted radiator and cooling system rated for full load operation in 104 degrees Fahrenheit (40 degrees Celsius) ambient as measured at the generator air inlet, based on 0.5 in H₂O external static head. Radiator shall be sized based on a core temperature that is 20 degrees Fahrenheit higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture. Rotating parts shall be guarded against accidental contact.
- .5 Electric starter(s) capable of three complete cranking cycles without overheating.
- .6 Positive displacement, mechanical, full pressure, lubrication oil pump.
- .7 Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.
- .8 Replaceable dry element air cleaner with restriction indicator.
- .9 Flexible fuel lines
- .10 Engine mounted battery charging alternator, 40 ampere minimum and solid-state voltage regulator.
- .11 Coolant heater
 1. Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be U.L. 499 listed and labeled.
 2. The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall be installed using quick disconnect couplers to isolate the heater for replacement of the heater element. The quick

- disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.
3. The coolant heater shall be provided with a 24 V.D.C. thermostat, installed at the engine thermostat housing. An A.C. power connection box shall be provided for a single A.C. power connection to the coolant heater system.
 4. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 100F (40 degrees Celsius) in a 40 degree Fahrenheit ambient, in compliance with N.F.P.A. 110 requirements, or the temperature required for starting and load pickup requirements of this specification.
- .12 Provide vibration isolators, spring/pad type or as recommended by the manufacturer, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.
 - .13 Starting and Control Batteries shall be calcium/lead antimony type, 24 volt D.C., sized as recommended by the engine manufacturer, complete with battery cables and connectors.
 - .14 A C.S.A. certified 10 amp voltage regulated battery charger shall be provided for each engine-generator set. The charger shall be mounted inside the enclosure. Input A.C. voltage and D.C. output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 10 amps, 120 V.A.C., 60 hertz. Charger shall include an D.C. voltmeter and ammeter, 12 hour equalize charge timer, and A.C. and D.C. fuses and shall be installed inside the generator enclosure.
 - .15 Provide manufacturer installed battery warmer rated at 120 V.A.C., 60 hertz.
- 2.6 A.C. Generator
- .1 The A.C. generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet N.E.M.A. MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees Celsius.
 - .2 The generator shall be capable of delivering rated output (kilovolt-ampere)

at rated frequency and power factor, at any voltage not more than five percent above or below rated voltage.

- .3 The subtransient reactance of the alternator shall not exceed 12 percent, based on the standby rating of the generator set.
- .4 The generator shall be supplied with a 600 volt 3 pole thermal magnetic 100 percent rated main breaker.
- .5 The generator shall be supplied with a 600 volt 3 pole thermal magnetic 100 percent rated breaker for load bank maintenance testing.

2.7 Generator Set Control

- .1 The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.
- .2 The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered. A second controller shall be remote mounted as noted on electrical plans.
- .3 Control Switches
 - 1. Mode Select Switch
 - .1 The mode select switch shall initiate the following control modes. When in the RUN or Manual position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - 2. RESET switch
 - .1 The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 - 3. PANEL LAMP switch
 - .1 Depressing the panel lamp switch shall cause the entire panel to be lighted with D.C. control power. The panel lamps shall automatically be switched off ten minutes after the switch is depressed, or after the switch is depressed a

second time.

.4 Generator Set A.C. Output Metering

1. The generator set shall be provided with a metering set including the following features and functions:
 - .1 Analog voltmeter, ammeter, frequency meter, and kilowatt (kilowatt) meter. Voltmeter and ammeter shall display all three phases. Ammeter and kilowatt meter scales shall be color coded in the following fashion: readings from 0 to 90 percent of generator set standby rating: green; readings from 90 to 100 percent of standby rating: amber; readings in excess of 100 percent: red.
 - .2 Digital metering set, 0.5 percent accuracy, to indicate generator R.M.S. voltage and current, frequency, output current, output kilowatt, kilowatt hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.
 - .3 Both analog and digital metering are required. The analog and digital metering equipment shall be driven by a single microprocessor, to provide consistent readings and performance.

.5 Generator Set Alarm and Status Display

1. The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing warning and shutdown conditions. The lamps shall be high-intensity L.E.D. type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on an alphanumeric digital display panel:
 - .1 low oil pressure (alarm)
 - .2 low oil pressure (shutdown)
 - .3 oil pressure sender failure (alarm)
 - .4 low coolant temperature (alarm)
 - .5 high coolant temperature (alarm)
 - .6 high coolant temperature (shutdown)
 - .7 engine temperature sender failure (alarm)

- .8 low coolant level (alarm or shutdown--selectable)
 - .9 fail to crank (shutdown)
 - .10 fail to start/overcrank (shutdown)
 - .11 overspeed (shutdown)
 - .12 low D.C. voltage (alarm)
 - .13 high D.C. voltage (alarm)
 - .14 weak battery (alarm)
 - .15 low fuel-daytank (alarm)
 - .16 high A.C. voltage (shutdown)
 - .17 low A.C. voltage (shutdown)
 - .18 under frequency (shutdown)
 - .19 over current (warning)
 - .20 over current (shutdown)
 - .21 short circuit (shutdown)
 - .22 over load (alarm)
 - .23 emergency stop (shutdown)
2. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.
- .6 Engine Status Monitoring
- 1. The following information shall be available from a digital status panel on the generator set control :
 - .1 engine oil pressure (p.s.i. or kilopascal)
 - .2 engine coolant temperature (degrees Fahrenheit or Celsius)
 - .3 engine speed (r.p.m.)
 - .4 number of hours of operation (hours)
 - .5 number of start attempts

.6 battery voltage (D.C. volts)

2. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

.7 Engine Control Functions

1. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and number of cycles. Initial settings shall be for three cranking periods of 15 seconds each, with 15 second rest period between cranking periods.
2. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
3. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.
4. The control system shall include time delay start (adjustable 0 to 300 seconds) and time delay stop (adjustable 0 to 600 seconds) functions.
5. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

.8 Alternator Control Functions

1. The generator set shall include an automatic digital voltage regulation system that is matched and prototype tested with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase R.M.S. sensing and shall control buildup of A.C. generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58 to 59] hertz. The voltage regulator shall include adjustments for gain, damping,

- and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric L.E.D. readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
2. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110 percent of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator. The protective functions provided shall be in compliance to the requirements of N.F.P.A.70 article 445.
 3. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of N.F.P.A.70 article 445.
 4. Controls shall be provided to monitor the kilowatt load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of five seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
 5. An A.C. over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110 percent of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130 percent. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85 percent for more than ten seconds.
 6. A battery monitoring system shall be provided which initiates alarms when the D.C. control and starting voltage is less than 25 V.D.C. or more than 32 V.D.C. During engine starting, the low voltage limit shall be disabled, and if D.C. voltage drops to less than 14.4 volts for more than two seconds a "weak battery" alarm shall be initiated.
- .9 The generator set shall be provided with a mounted main line circuit breaker, sized to carry the rated output current of the generator set. The

circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

2.8 Outdoor Weather-Protective Enclosure

- .1 The generator set shall be provided with a sound-attenuated housing (Level 2) which allows the generator set to operate at full rated load in an ambient temperature of up to 100 degrees Fahrenheit. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 68 d.B.A. at any location seven meters from the generator set in a free field environment. Exhaust Silencer of suitable grade to be provided to meet the required overall Sound Level. Silencer to be installed inside the enclosure and terminated through the roof. Provide a four inch rain cap shipped loose for installation on top of exhaust extension by Contractor.
- .2 The package shall comply with the requirements of the National Electrical Code for all wiring materials and component spacing. The total assembly of generator set, enclosure, and sub-base fuel tank (when used) shall be designed to be lifted into place using spreader bars. Housing shall provide ample airflow for generator set operation at rated load in an ambient temperature of 100 degrees Fahrenheit. The housing shall have hinged access doors as required to maintain easy access for all operating and service functions. All doors shall be lockable and include retainers to hold the door open during service. Enclosure roof shall be cambered to prevent rainwater accumulation. Openings shall be screened to limit access of rodents into the enclosure. All electrical power and control interconnections shall be made within the perimeter of the enclosure.
- .3 All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color using a two-step electro coating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating that meets the following requirements:
 1. Primer thickness, 0.5 to 2.0 millimeters Top coat thickness, 0.8 to 1.2 millimeters.
 2. Gloss, per A.S.T.M. D.523-89, 80 percent plus or minus five percent. Gloss retention after one year shall exceed 50 percent.
 3. Crosshatch adhesion, per A.S.T.M. D3359-93, 4B-5B.

4. Impact resistance, per A.S.T.M. D2794-93, 120 to 160 inch to pounds.
 5. Salt Spray, per A.S.T.M. B.117-90, 1000 plus hours.
 6. Humidity, per A.S.T.M. D.2247-92, 1000 plus hours.
 7. Water Soak, per A.S.T.M. D.2247-92, 1000 plus hours.
 8. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant and designed to minimize marring of the painted surface when removed for normal installation or service work.
 9. Enclosure shall be constructed of minimum 12 gauge steel for framework and 14 gauge steel for panels. All hardware and hinges shall be stainless steel.
 10. A factory-mounted exhaust silencer shall be installed inside the enclosure. The exhaust shall exit the enclosure through a rain collar and terminate with a rain cap. Exhaust connections to the generator set shall be through seamless flexible connections.
- .4 The enclosure shall include the following maintenance provisions for Flexible coolant and lubricating oil drain lines, that extend to the exterior of the enclosure, with internal drain valves
 - .5 Provide motorized louvers/dampers to minimize air flow through the enclosure when generator set is not operating. Louvers shall include provisions to prevent accumulation of ice or snow that might prevent operation and to maintain internal temperature at ten degrees Celcius per C.S.A. requirement. Provide internal lights, D.C. light and space heater to comply with C.S.A..
 - .6 The enclosure shall be insulated with non-hydroscopic materials.
- 2.9 Fabrication
- .1 The complete unit is to be shop fabricated and assembled, ready for delivery.
- 2.10 Transfer Switch
- .1 The transfer switch shall be supplied by the Generator Set Manufacturer and shall be suitable for the Genset supplied.
 - .2 Refer to separate Transfer Switch specification section.
- 2.11 Factory Testing
- .1 The generator set supplier shall perform a complete operational test on

the generator set prior to shipping from the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.

- .2 Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

Part 3 – Execution

3.1 Installation

- .1 Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- .2 Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
- .3 Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site. Provide grading to suit new concrete pad. Refer to details on drawings.
- .4 Complete wiring and interconnections as noted on drawings and as required for a complete and operational system.
- .5 Equipment shall be initially started and operated by representatives of the manufacturer.
- .6 All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to final testing of the system.

3.2 Vent Extension

- .1 Provide vent extension off top of generator vent outlet a minimum of 2m above the adjacent roof level. Vent extension shall be equipped with a proper vent termination stack rain cap.

- .2 Support vent extension from steel pole mounted to top of concrete pad.

3.3 Sequence of Operation

- .1 Generator set shall start on receipt of a start signal from remote equipment. The start signal shall be via hardwired connection to the generator set control.
- .2 The generator set shall complete a time delay start period as programmed into the control.
- .3 The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions:
 - 1. The control system shall verify that the engine is rotating when the starter is signaled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set, and indicate "fail to crank" shutdown.
 - 2. The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate "fail to start".
 - 3. The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed, and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.
- .4 On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous, synchronize, load share, load demand, or load govern state.
- .5 When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.
- .6 On completion of the time delay stop period, the generator set control shall switch off the excitation system and shall shut down.
 - 1. Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

3.4 On-Site Acceptance Test

- .1 The complete installation shall be tested for compliance with the

specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests.

- .2 Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two hour full load test, and a one step rated load pickup test in accordance with N.F.P.A. 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.

3.5 Training

- .1 The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided.
- .2 The training program shall be not less than six hours in total over multiple training sessions (up to three, two hour sessions). Training shall be coordinated with the Municipality.

3.6 Service and Support

- .1 The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.
- .2 The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
- .3 The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

3.7 Warranty

- .1 The generator set and associated equipment shall be warranted for a period of not less than one year from the date of commissioning against defects in materials and workmanship.
- .2 The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etcetera.

End of Section

Part 1 - General

1.1 Scope

- .1 Provide complete factory assembled power transfer equipment with field programmable digital electronic controls designed for fully automatic operation and including: surge voltage isolation, voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking, and mechanically held contacts for both sources.
- .2 The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for all the products provided. Technicians specifically trained to support the product and employed by the generator set supplier shall service the transfer switches. The generator set and transfer switch shall be warranted for one year.

1.2 Codes and Standards

- .1 The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:
 - .1 C.S.A. 282-15, Emergency Electrical Power Supply for Buildings
 - .2 N.F.P.A.70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
 - .3 N.F.P.A.110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems.
 - .4 I.E.E.E. 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
 - .5 N.E.M.A. I.C.S. 10-1993 – A.C. Automatic Transfer Switches.
- .2 The transfer switch assembly shall comply with the following standards:
 - .1 C.S.A. C22.2, No. 14 – M91 Industrial Control Equipment.
 - .2 E.N. 55011, Class B Radiated Emissions
 - .3 E.N. 55011, Class B Conducted Emissions
 - .4 I.E.C. 1000-4-5 (E.N. 61000-4-5) AC Surge Immunity.
 - .5 I.E.C. 1000-4-4 (E.N. 61000-4-4) Fast Transients Immunity
 - .6 I.E.C. 1000-4-2 (E.N. 61000-4-2) Electrostatic Discharge Immunity
 - .7 I.E.C. 1000-4-3 (E.N. 61000-4-3) Radiated Field Immunity
 - .8 I.E.C. 1000-4-6 Conducted Field Immunity

- .9 I.E.C. 1000-4-11 Voltage Dip Immunity.
 - .10 I.E.E.E. 62.41, A.C. Voltage Surge Immunity.
 - .11 I.E.E.E. 62.45, A.C. Voltage Surge.
 - .12 U.L. 1008 – Transfer Switches. Transfer switches shall be U.L. 1008 listed. U.L. 1008 transfer switches shall be supplied in U.L. 891 enclosures if necessary to meet the physical requirements of the project.
- .3 The transfer switch manufacturer shall be certified to I.S.O. 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with I.S.O. 9001.
- 1.3 Acceptable Manufacturers
- .1 Generator set manufacturers shall supply the transfer switch. Equipment specifications for this project are based on microprocessor-based transfer switches.

Part 2 - Products

2.1 Power Transfer Switch

- .1 Ratings
 - .1 The transfer switch shall be 400 ampere, 3-pole, 60 cycle, 3-phase, 600 V.A.C. with solid neutral sized for the new 300 kilowatt standby power generator. Transfer switch shall be double sided bypass.
 - .2 Main contacts shall be rated for 600 volts A.C. minimum.
 - .3 Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure supplied, in ambient temperatures of minus 40 to plus 60 degrees Celsius, relative humidity up to 95 percent (non-condensing), and altitudes up to 10,000 feet (3000 meters).
 - .4 Transfer switch equipment shall have withstand and closing ratings (W.C.R.) in R.M.S. symmetrical amperes greater than the available fault currents shown on the drawings and at the specified voltage. The transfer switch and its upstream protection shall be coordinated. The transfer switch shall be third party listed and labeled for use with the specific protective device(s) installed in the application.
- .2 Construction
 - .1 Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the source one and source two

positions. The transfer switch shall be specifically designed to transfer to the best available source if it inadvertently stops in a neutral position.

- .2 Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact mechanisms.
 - .3 Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
 - .4 Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism.
 - .5 Power transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.
 - .6 Transfer switches designated on the drawings as 4-pole shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Substitute equipment using overlapping neutral contacts is not acceptable.
 - .7 Transfer switches that are designated on the drawings as 3-pole shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100 percent of the current designated on the switch rating.
 - .8 The transfer switch shall be factory mounted in a custom cabinet designed to interface with the existing Commander switchgear. The cabinet will include space for buss extensions and terminal lugs to extend cable to the transfer switch terminals. Include for all required buss, barriers and cable supports.
- .3 Connections
- .1 Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
 - .2 Transfer switch shall be provided with A.L./C.U. mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.

2.2 Transfer Switch Control

- .1 Operator Panel: Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be a sealed membrane panel rated N.E.M.A. 3R/I.P.53 or better (regardless of enclosure rating) that is permanently labeled for switch and control functions. The operator panel shall be provided with the following features and capabilities:
 - .1 High intensity L.E.D. lamps to indicate the source that the load is connected to (source one or source two); and which source(s) are available. Source available L.E.D. indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.
 - .2 High intensity L.E.D. lamps to indicate that the transfer switch is “not in auto” (due to control being disabled or due to bypass switch (when used) enabled or in operation) and “Test/Exercise Active” to indicate that the control system is testing or exercising the generator set.
 - .3 “OVERRIDE” pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation.
 - .4 “TEST” pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load.
 - .5 “RESET/LAMP TEST” pushbutton that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.
 - .6 The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. This information shall be available via a P.C. based service tool and an operator display panel.
 - .7 Security Key Switch to allow the user to inhibit adjustments, manual operation or testing of the transfer switch unless key is in place and operated.
 - .8 Analog A.C. meter display panel, to display 3-phase A.C. amperes, 3-phase A.C. volts, hertz, kilowatt load level, and load power factor. The display shall be color-coded, with green scale indicating normal or acceptable operating level, yellow indicating conditions nearing a fault, and red indicating operation in excess of rated conditions for the transfer switch.

- .9 Vacuum fluorescent alphanumeric display panel with push-button navigation switches. The display shall be clearly visible in both bright (sunlight) and no light conditions. It shall be visible over an angle of at least 120 degrees. The alphanumeric display panel shall be capable of providing the following functions and capabilities:
 - .1 Display source condition information, including A.C. voltage for each phase of normal and emergency source, frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance. Line to neutral voltages shall be displayed for 4 wire systems.
 - .2 Display source status, to indicate source is connected or not connected.
 - .3 Display load data, including 3-phase A.C. voltage, 3-phase A.C. current, frequency, kilowatt, kilovolt-ampere, and power factor. Voltage and current data for all phases shall be displayed on a single screen.
 - .4 The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:
 - .1 Set nominal voltage and frequency for the transfer switch.
 - .2 Adjust voltage and frequency sensor operation set points.
 - .3 Set up time clock functions.
 - .4 Set up load sequence functions.
 - .5 Enable or disable control functions in the transfer switch, including program transition.
 - .6 Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.
 - .5 Display Real time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.
 - .6 Display service history for the transfer switch. Display source connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.

- .7 Display fault history on the transfer switch, including condition, and date and time of fault. Faults to include controller checksum error, low controller D.C. voltage, A.T.S. fail to close on transfer, A.T.S. fail to close on retransfer, battery charger malfunction, network battery voltage low, network communications error.
- .2 Internal Controls
- .1 The transfer switch control system shall be configurable in the field for any operating voltage level up to 600 V.A.C. Provide R.M.S. voltage sensing and metering that is accurate to within plus or minus 1 percent of nominal voltage level. Frequency sensing shall be accurate to within plus or minus 0.2 percent. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
 - .2 Transfer switch voltage sensors shall be close differential type, providing source availability information to the control system based on the following functions:
 - .1 Monitoring all phases of the normal service (source one) for under voltage conditions (adjustable for pickup in a range of 85 to 98 percent of the normal voltage level and dropout in a range of 75 to 98 percent of normal voltage level).
 - .2 Monitoring all phases of the emergency service (source two) for under voltage conditions (adjustable for pickup in a range of 85 to 98 percent of the normal voltage level and dropout in a range of 75 to 98 percent of pickup voltage level).
 - .3 Monitoring all phases of the normal service (source one) and emergency service (source two) for voltage imbalance.
 - .4 Monitoring all phases of the normal service (source one) and emergency service (source two) for loss of a single phase.
 - .5 Monitoring all phases of the normal service (source one) and emergency service (source two) for phase rotation.
 - .6 Monitoring all phases of the normal service (source one) and emergency service (source two) for over voltage conditions (adjustable for dropout over a range of 105 to 135 percent of normal voltage, and pickup at 95 to 99 percent of dropout voltage level).
 - .7 Monitoring all phases of the normal service (source one) and emergency service (source two) for over or under frequency conditions.

- .8 Monitoring the neutral current flow in the load side of the transfer switch. The control shall initiate an alarm when the neutral current exceeds a preset adjustable value in the range of 100 to 150 percent of rated phase current for more than an adjustable time period of 10 to 60 seconds.
- .3 All transfer switch sensing shall be configurable from a Windows P.C. based service tool, to allow setting of levels, and enabling or disabling of features and functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. Designs utilizing D.I.P. switches or other electromechanical devices are not acceptable. The transfer control shall incorporate a series of diagnostic L.E.D. lamps.
- .4 The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature and adjusting the time period to a specific value. A phase band monitor or similar device is not an acceptable alternate for this feature.
- .5 The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0 to 15 seconds); transfer (adjustable in a range from 0 to 120 seconds); retransfer (adjustable in a range from 0 to 30 minutes); and generator stop (cooldown) (adjustable in a range of 0 to 30 minutes).
- .6 The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device for load shedding purposes. On receipt of this signal, the transfer switch shall switch to a neutral position when connected to source two. If source one is available when the load-shed signal is received, the transfer switch shall connect to source one.
- .7 The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.
- .8 The transfer switch shall provide a relay contact signal prior to transfer or retransfer. The time period before and after transfer shall be adjustable in a range of 0 to 50 seconds.
- .9 The control system shall be designed and prototype tested for operation in ambient temperatures from minus 40 degrees Celsius to plus 70 degrees Celsius. It shall be designed and tested to comply with the requirements of the noted voltage and R.F.I./E.M.I. standards.

- .10 The control shall have optically isolated logic inputs, high isolation transformers for A.C. inputs, and relays on all outputs, to provide optimum protection from line voltage surges, R.F.I. and E.M.I.
- .3 Control Interface
 - .1 The transfer switch will provide an isolated relay contact for starting of a generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C., for compatibility with any generator set.
 - .2 Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amperes 250 V.A.C.
 - .3 The transfer switch shall provide relay contacts to indicate the following conditions: source one available, load connected to source one, source two available, source two connected to load.
 - .4 The transfer switch shall provide auxiliary contacts for annunciation at the security alarm control panel for generator running status and for a common alarm to annunciate upon any conditions noted on drawings.

2.3 Enclosure

- .1 Enclosures shall be U.L. listed. The enclosure shall provide wire bend space in compliance to the latest version of N.F.P.A.70. The cabinet door shall include permanently mounted key type latches.
- .2 Transfer switch equipment shall be provided in a N.E.M.A. 3R or better enclosure.
- .3 The cabinet shall provide code-required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches with manual operating handles and/or non key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

Part 3 - Execution

3.1 Operation

- .1 Open Transition Sequence of Operation
 - .1 Transfer switch normally connects an energized utility power source (source one) to loads and a generator set (source two) to the loads when normal source fails. The normal position of the transfer switch is source one (connected to the utility), and no start signal is supplied to the genset.

- .2 Generator Set Exercise (Test) With Load Mode. The control system shall be configurable to test the generator set under load. In this mode, the transfer switch shall control the generator set in the following sequence:
 - .1 Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
 - .2 The transfer switch shall issue a compatible start command to the generator when the control systems senses the generator set at rated voltage and frequency, it shall operate to connect the loads to the generator set by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.
 - .3 The generator set shall operate connected to the load for the duration of the exercise period. If the generator set fails during this period, the transfer switch shall automatically reconnect the generator set to the normal service.
 - .4 On completion of the exercise period, the transfer switch shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.
 - .5 The transfer switch shall operate the generator set unloaded for a cooldown period, and then remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.
- .3 Generator Set Exercise (Test) Without Load Mode. The control system shall be configurable to test the generator set without transfer switch load connected. In this mode, the transfer switch shall control the generator set in the following sequence:
 - .1 Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
 - .2 When the control systems senses the generator set at rated voltage and frequency, it shall operate the generator set unloaded for the duration of the exercise period.

- .3 At the completion of the exercise period, the transfer switch shall remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

3.2 Factory Testing

- .1 The transfer switch manufacturer shall perform a complete operational test on the transfer switch prior to shipping from the factory. A certified test report shall be available on request. Test process shall include calibration of voltage sensors.

3.3 Service and Support

- .1 The manufacturer of the transfer switch shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.
- .2 The transfer switch shall be serviced by a local service organization that is trained and factory certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
- .3 The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.
- .4 After generator set installation, the generator set supplier shall conduct complete operation, basic maintenance, and emergency service training for up to 10 persons employed by the facility owner. The training shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the P.C. based service and maintenance tools provided under this contract, and emergency operation procedures. The training shall include practical operation with the installed equipment. Refer to Natural Gas Generator Specifications for training hours to be included.

End of Section

Part 1 - General

1.1 Codes and Standards

- .1 Ontario Electrical Safety Code – Current Edition
- .2 C.S.A.
- .3 U.L.C.
- .4 Local Codes and Requirements

1.2 Submittals

- .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .2 Shop drawings shall include manufacturer, model numbers, electrical data, wiring diagrams, and indicate conformance to above reference standards.

Part 2 - Products

2.1 Fixtures

- .1 Luminaires including fixtures and lamps shall conform to the light fixture schedule.
- .2 Manufacturer:
 - .1 Acceptable Manufacturers:
 - 1. Troffer: Phillips, Acuity, Visioneering, Peerless-Electric, Columbia Lighting.
 - 2. Down Lights : Philips, Acuity, Prescolite
 - 3. High Bay : Philips, Acuity, Visioneering, Columbia Lighting, Peerless-Electric.
 - 4. Strip Lights : Philips, Acuity, Peerless-Electric, Visioneering.
 - 5. Suspended : Philips, Acuity, Visioneering, Pinnacle
 - 6. Exterior : Philips, Acuity, Spaulding Lighting, LSI, Leotek
 - 7. Soffit Light (S1): Contech Lighting, Philips, Acuity, Spaulding Lighting, LSI, Stan Pro
 - 8. Exterior Wall Pack (W1): XtraLight, Philips, Acuity, Spaulding Lighting, LSI, Stan Pro

- .2 Alternate manufacturers must provide equal fixtures to the satisfaction of the Engineer. Any alternates that do not satisfy the specifications or the Engineer will be rejected.
- .3 Alternate fixtures must be on approved D.L.C. list if base spec fixtures is on approved list for applicable energy benefits.
- .4 Where alternates alter functional or visual design, or change the space requirements or mounting details, all such information shall be clearly presented to the Consultant for consideration and any costs associated with same shall be the responsibility of the Contractor.
- .5 Once shop drawings are approved, no substitutions will be considered except for special circumstances such as delivery. Delivery reasons shall only be considered if at no fault to the Contractor. Contractor's failure to order fixtures within the schedule will not be acceptable.
- .3 Similar luminaires shall be products of same manufacturer.
- .4 Luminaires shall be completely factory assembled and delivered in cartons or in palletized form.
- .5 All fixtures shall be recessed type in acoustic tile or drywall ceilings unless otherwise indicated. Provide drywall trim frame for recessed drywall applications.
- .6 Troffers in ceiling shall be equipped with adjustable mounting brackets.
- .7 All fixtures shall be provided with ballasts suitable for the fixture type and application. All ballasts shall C.S.A. approved and U.L.C. listed and comply with C.S.A. standard C22.2 No. 74. Ballasts shall be suitable for 120 volt application as noted.
- .8 Protective wire guards shall be provided for all fixtures where indicated on the drawings and where subject to damage.

2.2 Lenses

- .1 In general, lenses shall be K12 distribution acrylic 0.125 inch (32 millimeters) thick, shall have a recessed prismatic pattern of 3/16 inches (5 millimeters) square based female cones running 45 degrees to the parallel and perpendicular axis to the panel. Provide vandal lenses where specified.
- .2 Panel shall be made of ultraviolet inhibited injection moulded clear virgin acrylic.
- .3 Panels shall be strain free and uniform in production. There shall be no fade-outs or streaks to detract from job performance.

- .4 Lenses shall be low brightness, sparkling crystal panel that provides maximum efficiency and good brightness control in the direct glare zone.

2.3 Solid State Drivers

- .1 Drivers shall be U.L./C.S.A. approved for application required and meet all applicable C.E.C., N.E.M.A. and A.N.S.I. Standards.
- .2 Driver to provide full-range dimming, 0-10 volts, where indicated.
- .3 Drivers shall comply with N.E.M.A. limits governing electromagnetic and radio frequency interference and shall not interfere with operation of other normal electrical equipment.
- .4 Driver shall meet A.N.S.I. Spec C62.41 and I.E.E.E. standards regarding all applicable transient protection.
- .5 Frequency of operation shall be 20 kilohertz or greater.
- .6 Driver shall have an 'A' sound rating.
- .7 Total harmonic distortions shall be less than 10%. Meet A.N.S.I. C82.77.
- .8 Drivers shall have a power factor of 0.85 minimum.
- .9 Driver warranty shall be minimum five (5) years.

2.4 L.E.D.s

- .1 Shall conform to A.N.S.I. C78.377 (latest edition)
- .2 L.E.D.s shall be 4500K unless otherwise noted. Verify colour of L.E.D.s before ordering.
- .3 L.E.D.s shall provide a minimum 80 C.R.I. unless otherwise noted.
- .4 L.E.D. life shall be minimum 50,000 hours. L.E.D.s shall be rated for L70 life span.
- .5 Warranty shall be minimum 5 years.

2.5 Down lights

- .1 Shallow construction
- .2 Damp location rated for exterior mounting where noted
- .3 Exterior down lights to come with adjustable trim/lamp
- .4 Lamp to be L.E.D.
- .5 Colour temperature to be 3500 k.

Part 3 – Execution

3.1 General

- .1 Luminaires shall be stored in a dry and protected area. Confirm acceptable storage area prior to luminaire being delivered to site.
- .2 Lenses for fixtures shall be stored on site and installed separately from the fixtures at a time to be directed by the Consultant.

3.2 Installation of Lighting Fixtures

- .1 Provide all lighting fixtures and lamps as shown on the drawings and schedules.
- .2 Include for assembly, and mounting of all fixtures, complete with all wiring, connections, fittings, hangers, aligners, box covers and accessories which may be required for any fixture to provide a complete, safe, fully operational assembly.
- .3 Install fixtures in accordance with applicable reflected ceiling plans and/or as directed by the Consultant.
- .4 In Equipment Rooms, shafts and similar secondary areas, install fixtures after the mechanical and other major work is roughed-in and adjust fixture locations as required at no cost to the Owner. Fixtures in these areas shall be installed at the same height unless otherwise directed.
- .5 At the discretion of the Consultant, site test and demonstrate the operation of special application fixtures and adjust their locations within a reasonable distance to obtain the effects desired. Assist in the aligning and positioning of all adjustable fixtures, and ensure that fixtures with adjustable lamp holders are properly positioned to correspond with the lamps specified.
- .6 Thoroughly review all ceiling types, construction details and mounting arrangements before placing fixture orders and ensure that all mounting assemblies, frames, rings and similar features are included for and match the required installation.
- .7 Mount luminaires perfectly level and plumb. Luminaires shall fit tightly to ceiling without showing a space or light leak between frame and ceiling. Re-install improperly installed fixtures at no expense to the Owner.
- .8 All fixtures and fixture assemblies shall be properly secured and supported. Support fixtures independent of the ceiling construction complete with all fasteners, framing and hangers as required. Do not secure fixtures to mechanical ductwork or other vibration producing apparatus.

- .9 Where fixtures are suspended from the structure they shall utilize self aligning box covers with an additional ground wire from the outlet through the hanger for continuity of ground.
- .10 Carefully co-ordinate the fixture installation with the work of other trades ensuring that the necessary depths and mounting spaces are provided. Do not alter fixture locations unless approved by the Consultant.
- .11 Provide safety chains on all surface mounted, T-bar mounted or suspended light fixtures. Light fixtures shall have two chains, each supporting two corners of the luminaire (all four corners supported). Chain shall be #10 tensile jack chain, bright inc coated, with a strength of 400 pounds (180 kilograms). Attachments shall be made using a No. 10 "S" hook. Caddy fasteners may be used where applicable. "S" hooks must be closed after installation.
- .12 Industrial luminaires, where suspended, shall have ½ inch (12 millimeters) conduit hangers and ARB cylinder ball aligners. Length and location shall clear equipment, ducts and pipes. Metal strut (Flexibar or equal) may be used for mounting of luminaires in mechanical areas or electrical rooms.

End of Section

Part 1 - General

1.1 Codes and Standards

- .1 Ontario Electrical Safety Code – Current Edition
- .2 C.S.A. Z32
- .3 U.L.C.
- .4 Local Codes and Requirements

1.2 Submittals

- .1 Shop Drawings:
 - .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
 - .2 Shop drawings shall include manufacturer, model numbers, electrical data, wiring diagrams, and indicate conformance to above reference standards.
 - .3 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.
- .2 Operation and Maintenance Data:
 - .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
 - .2 Operation and maintenance data shall be included in the maintenance manual.

1.3 Acceptable Manufacturers

- .1 EmergiLite
- .2 Lumacell
- .3 Beghelli
- .4 AimLite
- .5 Stanpro

Part 2 – Products

2.1 Battery Units

- .1 New batteries shall be 12 volt D.C. and shall be designed to supply all units and all connected remote heads for a period of one half hour to an end voltage of 91 percent. The fully automatic charger shall regulate the

charging current according to battery need and provide full recharge in 12 hours or less after full discharge.

- .2 Battery units shall be complete with long life lead batteries, 10-year warranty and type integral heads as indicated on the drawings. Capacities shall be as noted on the drawings. Provide white finish.
- .3 Battery units shall provide the required operating time for all connected lights and signs under emergency conditions in conformance with the O.B.C.
- .4 Battery Units shall have line cord kit.

2.2 Remote Emergency Lights

- .1 Lamp head and stem shall be injection molded, impact resistant, flame retardant thermoplastic, factory white.
- .2 Lamp type to be L.E.D. Provide wattage as indicated on drawings.
- .3 The lens shall be inverse concave design and fully adjustable for aisle or area distribution during installation without the need to energize the lamp.
- .4 Visual identification of distribution shall be provided through position of adjustment pins.
- .5 Fixture shall be supplied with a canopy for installation on any four inch octagon box.
- .6 Housing shall be so designed to allow for lamp replacement if required.
- .7 Provide protective cages over lights in gymnasiums and other areas where they would be susceptible to damage.

2.3 Pictogram (Exit) Signs

- .1 Exit signs shall be C.S.A.-22.2 Number 141-10 approved.
- .2 Exit signs shall have white running man on green background complete with directional arrow where required and noted.
- .3 Exit signs shall operate with universal A.C. input voltage as per site conditions at less than 1.5 watts and universal two-wire D.C. input voltage from 6 volts D.C. to 24 volts D.C. at less than 1.5 watts for single and double face signs.
- .4 The exit sign shall be suitable for wall, end or ceiling mount.
- .5 The faceplates shall be constructed of robust clear poly carbonate panel with multiple legend plates provided for field selectable directional routing.
- .6 The frame shall be of a one-piece steel construction painted factory white.

- .7 The light source shall be light emitting diodes (L.E.D.). The L.E.D. lamps shall provide illumination in normal and emergency operation and shall be mounted inside the exit housing, no on the face.
- .8 An L.E.D. sensitive diffuser shall be mounted behind the legend to provide the letters with even illumination.
- .9 The exit sign in a self-powered configuration shall stay illuminated during emergency operation for at least two hours upon A.C. failure.
- .10 Provide protective cages over lights in areas where they would susceptible to damage.

Part 3 – Execution

3.1 General

- .1 Installation of system equipment shall be in accordance with Canadian Electrical Code and Ontario Building Code.

3.2 Battery Units

- .1 Provide 120 volts receptacle for each battery unit mounted adjacent and at height of battery unit.

3.3 Emergency Lights

- .1 Provide emergency lighting on battery back-up as indicated on the drawings.
- .2 Emergency lighting is required to provide an average level of illumination of not less than 10 lux at floor level and a minimum level of 1 lux.
- .3 Emergency Lights shall be mounted as noted on drawings. Where wall mounting is shown, mount 2.45 meters (8 feet) above finished floor to the underside of the fixture. Where the ceiling height does not permit this mounting height, the minimum acceptable height is 2.13 meters (7 feet).
- .4 Provide protective cages over lights in gymnasiums and other areas where they would susceptible to damage.
- .5 Provide an additional 10 single head remotes and 5 double head remotes to be installed after light level tests at the discretion of the Consultant and/or Building Inspector. Installation of spare devices shall be based on lowest wattage lamp indicated on drawings and include labour and material based on 5000 millimeters of conduit and wire.

2.4 Pictogram (Exit) Signs

- .1 Every Exit Sign shall be visible from the exit approach. Provide suitable arrows or chevrons indicating direction of egress as required.

- .2 Exit signs shall be illuminated continuously.
- .3 Exit lights shall be mounted 2.45 meters (8 feet) above finished floor to the underside of the fixture. Where the ceiling height does not permit this mounting height the minimum acceptable height is 2.13 meters (7 feet).
- .4 Exit lights at doors shall be mounted above the door where space permits otherwise it can be mounted directly adjacent to it but ensuring it is visible from the exit approach.
- .5 Provide protective cages over lights in gymnasiums and other areas where they would be susceptible to damage.
- .6 Provide an additional 5 exit signs to be installed at the discretion of the Consultant and/or Building Inspector. Installation of spare devices shall include mobilization if required and labour and material based on 5000mm of conduit and wire.

3.4 Installation

- .1 Include all necessary conduits, wiring and lamps for a complete operating system.
- .2 Panel breakers feeding emergency lighting and exit lights shall be complete with circuit breaker lock-off device.
- .3 Wiring to remote heads and exit light D.C. sockets shall be sized for a maximum voltage drop of 5 percent. In no case shall wiring be less than #10 A.W.G. Provide separate circuits for all exit lighting using separate raceways from non-emergency wiring.

3.5 Verification

- .1 Following completion of the exit and emergency lighting installation, conduct tests of each system component and confirm battery operation life under emergency conditions.
- .2 Conduct light level tests in upgraded areas upon completion of emergency lighting system installation.
- .3 Upon completion of the tests, issue to the Consultant and Building Inspector a report for each test. Reports shall include:
 - .1 As-built location of each component
 - .2 Confirmation that it will remain operational for minimum required time in conformance with O.B.C.
 - .3 Light level readings
 - .4 Technician's name and signature that performed the tests

- .5 Owner Representative's name and signature that witnessed the tests.
- .4 Verify all emergency lighting systems in area of work to the Consultant and Building Inspector as requested by them.

End of Section

Part 1 - General

1.1 References

- .1 C.A.N./U.L.C.-S524 (latest edition), Installation of Fire Alarm Systems.
- .2 U.L.C.-S525 (latest edition), Audible Signal Appliances for Fire Alarm Systems.
- .3 C.A.N./U.L.C.-S526 (latest edition), Visual Signal Appliances, Fire Alarm.
- .4 C.A.N./U.L.C.-S527 (latest edition), Control Units, Fire Alarm.
- .5 C.A.N./U.L.C.-S528 (latest edition), Manual Pull Stations.
- .6 C.A.N./U.L.C.-S529 (latest edition), Smoke Detectors.
- .7 C.A.N./U.L.C.-S530 (latest edition), Heated Actuated Fire Detectors, Fire Alarm.
- .8 C.A.N./U.L.C.-S531 (latest edition), Smoke Alarms.
- .9 C.A.N./U.L.C.-S536 (latest edition), Inspection and Testing of Fire Alarm Systems.
- .10 C.A.N./U.L.C.-S537 (latest edition), Verification of Fire Alarm Systems.
- .11 OBC-2006, Ontario Building Code.

1.2 Description of System

- .1 System includes:
 - .1 Control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.
 - .2 Trouble signal devices.
 - .3 Power supply facilities.
 - .4 Addressable manual alarm stations.
 - .5 Addressable automatic alarm initiating devices.
 - .6 Audible and visual signal devices.
 - .7 End-of-line devices.
 - .8 Annunciators.
 - .9 Ancillary devices.
 - .10 Interface and zone modules.

1.3 Requirements of Regulatory Agencies

- .1 This system is subject to review by local building department officials, local fire department officials. Therefore, submission of verification certificate and field technical device verification sheets is required prior to inspection by these officials. Schedule accordingly.

1.4 Shop Drawings

- .1 Submit shop drawings in accordance with Section 26 05 01.
- .2 Include:
 - .1 Layout of equipment
 - .2 Zoning
 - .3 Complete wiring diagram

1.5 Operation and Maintenance Data

- .1 Provide operation and maintenance data for Fire Alarm System for incorporation into manual specified in Section 26 05 01.
- .2 Include:
 - .1 Operation and maintenance instructions for complete fire alarm system to permit effective operation and maintenance.
 - .2 Technical data – illustrated parts list with parts catalogue numbers.
 - .3 Copy of approved shop drawings.
 - .4 List of recommended spare parts for system.

1.6 Maintenance Materials

- .1 10 percent spare glass rods for total number of manual pull box stations if applicable.

1.7 Training

- .1 Arrange to pay for on-site demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system. Obtain written receipt of training session and include in maintenance manual.

1.8 System Operation

- .1 Operation of any alarm initiating device to:
 - .1 Cause audible and visual signal devices to sound throughout building.

- .2 Transmit signal to fire department via monitoring station.
 - .3 Cause zone of alarm device to be indicated on control panel and remote annunciator(s).
 - .4 Cause air conditioning and ventilating fans to shut down and to function so as to provide required control of smoke movement.
 - .5 Cause fire doors and smoke control doors of normally held open, to close automatically.
 - .6 Log the alarm in the historical alarm log file.
- .2 System Reset
- .1 It shall be possible to reset the fire alarm system until all the alarm zones have been properly reset or cleared.
- .3 System Trouble Operation
- .1 A trouble initiated by the actuation of a sprinkler system supervisory trouble switch shall cause the following to occur:
 - .1 An audible and visual trouble signal shall sound at the main control panel only until acknowledge by an operator.
 - .2 Annunciate the Supervisory Trouble Alarm at the main control panel L.C.D. Display and all remote annunciator(s).
 - .3 Log the Supervisory Trouble Alarm in the Historical Trouble Log File.
 - .4 Cause the remote trouble indicator to activate.
 - .2 Any system trouble shall cause the following to occur:
 - .1 An audible and visual trouble signal shall sound at the main control panel L.C.D. Display Only until acknowledged by an operator.
 - .2 Log the trouble condition in the separate Historical Trouble Log File.
- 1.9 Performance Criteria
- .1 These specifications describe the minimum functional requirements for an electronically supervised, microprocessor based, fully integrated system. The initial installation shall include all the necessary electronic hardware, software and memory for a completely operable system in accordance with these specifications.
- 1.10 Quality Assurance

- .1 Each and all items of the fire alarm system shall be listed as the products of a single manufacturer under the appropriate category by the Underwriter's Laboratories of Canada and shall bear the "U.L.C." label.
- .2 Each and all items of the fire alarm system shall be covered by a one year parts and labour warranty covering defects resulting from faulty workmanship and materials. The warranty shall be deemed to begin on the date the system is accepted by the Project Manager on issuance of the substantial performance certificate for the project.
- .3 All control equipment must have Transient Protection Devices to comply with U.L.C. requirements.

1.11 Approved Manufacturer

- .1 Mircom
- .2 Edwards
- .3 Simplex
- .4 Notifier

Part 2 - Products

2.1 General

- .1 The fire alarm system shall be an addressable, single stage, zoned, non-coded, indicating, fully integrated fire alarm.
- .2 The fire alarm control panel shall allow for loading or editing of special instructions and operating sequences as required. The system shall be capable of on-site programming to accommodate expansion, and changes required by local codes. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.
- .3 The ability to selectively program input/output control functions based on ANDing, ORing, NOTing, Timed and Special Coded Operations is also to be incorporated in the resident software programming of the system.
- .4 The system shall have the ability to manually disable and enable any device/circuit individually for maintenance or testing purposes.
- .5 It shall be possible to reprogram selected or all smoke detector initiating zones for alarm verification.
- .6 It shall be possible to program an adjustable time delay circuit for each waterflow initiating circuit to prevent false alarms that may be caused by erroneous pressure surges in the sprinkler system.

- .7 All on site programming changes to the fire alarm system shall be password protected.
- .8 Wiring to any remote annunciator shall be supervised for open and ground conditions. A separate annunciator trouble indicator must be provided at the control panel, which shall illuminate and an audible trouble signal shall sound at the control panel upon the detection of an open or ground condition.
- .9 All Control Panels and Remote Annunciator Cabinets are to be properly grounded to building ground. Conduit ground will not be acceptable. The green coloured grounding loop shall be a minimum #14 AWG insulated copper conductor run in conduit. The ground loop shall be connected to building water supply to the line side of the water meter. Ground wire must not be run in same conduit as the Fire Alarm wiring.

2.2 Power Requirements

- .1 The control panels shall receive 120 V.A.C. power via a dedicated overcurrent protected circuit. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel and the remote annunciator. A green "Power On" L.E.D. shall be displayed continuously while incoming power is present.
- .2 Control Panel output power supply shall have the following operating characteristics:
 - .1 Rated for five Amps continuous duty
 - .2 24 V.D.C. filtered and regulated
 - .3 Power limited with a range of 20.4 V.D.C. to 32 V.D.C..
 - .4 Automatic "Brownout" transfer to standby batteries when supply voltage falls to 102 V.A.C..
- .3 The system shall be provided with a sufficient standby capacity to operate the entire system upon loss of normal 120 V.A.C. power in a normal supervisory mode for a period of twenty-four hours with two hours of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.
- .4 Battery charger shall have the following operating characteristics:
 - .1 Ability to charge a range up to 33 A.H. to 70 percent of their capacity within 12 hours.

- .2 Compatible with either lead acid or nicad batteries.
 - .5 All circuits requiring system operating power shall be individually fused at the control panel.
 - .6 The system shall be modular in design to allow future expansion with a minimum of hardware additions and system interruptions.
- 2.3 Fire Alarm Control Panel
- .1 The fire alarm control panel construction shall be modular in design with solid state microprocessor based electronics. An 80 character Liquid Crystal Display shall indicate alarms, supervisory service conditions and any troubles. The panel shall include but not be limited to the following:
 - .1 80 character L.C.D. display
 - .2 Local Energy, Shunt Master Box, or Reverse Polarity Remote Station Connection
 - .3 Form C. Trouble Contact
 - .4 Earth Ground Supervision Circuit
 - .5 Basic 8 A. power supply
 - .6 Automatic Battery Charger
 - .7 Standby Batteries
 - .8 Resident non-volatile programmable operating system memory for all operating requirements.
 - .9 Five Programmable Multi-Function keys with status L.E.D.'s
 - .10 Red Alarm L.E.D. and Acknowledge Button
 - .11 Yellow Supervisory Service L.E.D. and Acknowledge Button
 - .12 Yellow Trouble L.E.D. and Acknowledge Button
 - .13 Green Power on L.E.D.
 - .14 Alarm/Signal Silence Button
 - .15 System Reset Button
 - .16 Operator Interface Keypad for Manual Control and System Information Access
 - .17 Addressable Interface Control Card
 - .18 Supervised Annunciator Circuit
 - .2 The control panel shall be capable of chronologically logging and storing

300 events in an alarm log and 300 events in a trouble log. The historical logs shall be stored in the C.P.U.'s memory and shall be protected by a lithium battery that is supervised for a low battery condition. Each recorded event shall include the time and date of that event's occurrence. The alarm log file must be separate from the trouble log file. It shall be possible for the user to generate a report of both logs upon request.

- .3 All auxiliary manual controls shall be supervised so that all switches must be returned to the normal automatic position to clear system trouble.
- .4 Signal Circuits shall be independently supervised and fused such that a fault on one circuit shall not affect the operation of any of the other circuits. All signal circuits shall be configured as follows:
 - .1 Class "A" wiring, current limited.
 - .2 Rated at two Amps of continuous power.
 - .3 Capable of powering polarized 24 V.D.C. audible and visual signaling appliances.
- .5 Provide dry contact auxiliary control circuits as follows:
 - .1 Central Station alarm output.
 - .2 Central Station trouble output.
 - .3 SPDT Form C relays fused at 2 A. at 24 V.D.C..
- .6 System Expansion Modules connected by ribbon cables shall be supervised for module placement. Should a module become disconnected the system trouble indicator must illuminate and audible trouble signal must sound.
- .7 The Fire Alarm Control Panel shall be capable of supporting RS-232-C I/O ports. C.P.U. data output to the I/O ports shall be in parallel A.S.C.I.I. format at field adjustable baud rates of 220, 300, 1200, 2400 and 4800.
- .8 A walk test feature must be provided.
- .9 All system controls shall be housed in a surface wall mounted steel cabinets. Finish shall be according to the manufacturer's standards.
- .10 All modules shall be secured behind hinged locked door with a full viewing tempered plastic window. The hinged locked doors shall give access to all the operating controls but shall not expose live connections.
- .11 All internal wiring, control circuits, connections and terminals shall only be accessible behind a removable metal retainer plate.
- .12 All Cabinets are to be properly grounded to building ground. Conduit ground will not be acceptable.

- .13 The system must provide communication with addressable initiating devices. All of these devices will be annunciated on the control panel's main L.C.D. display. Annunciation shall include the following conditions for each point:
 - .1 40 Character Zone/Device Location
 - .2 Type of Device
 - .3 Detector Status (Normal/Alarm/Trouble)
 - .4 Device Missing/Failed
- .14 The communication format must be a completely digital poll/response protocol to allow tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol.
- .15 Each addressable device must be uniquely identified by an address code entered on each device base at time of installation. The use of jumpers to set address will not be acceptable due to the potential of vibration and poor contact.
- .16 It shall be possible for the owner's representative to change a smoke detector without any special tools or programming.
- .17 The system shall support 100 percent of addressable devices in alarm or operated at the same time, under both primary (A.C.) and secondary (battery) power conditions. Systems, which cannot support 100 percent of their point capacity in alarm simultaneously, cannot assure appropriate system response and are not acceptable.
- .18 The appropriate quantity of isolator modules shall be installed so that a wiring fault (short, open or ground) within one floor area shall not prevent the normal operation of other addressable devices on other floor areas.
- .19 The system shall maintain the sensitivity level set, for each sensor, over time by automatically compensating for environmental factors such as dust and dirt accumulations in a smoke sensor's chamber. The smoke sensor shall be a smoke density measuring device having no self-contained set-point. The control panel shall determine the alarm decision for each sensor.
- .20 The system shall automatically indicate when an individual sensor needs cleaning. When a sensor's average value reaches a predetermined value a 'Dirty Sensor' trouble condition shall be audibly and visually indicated at the control panel for the individual sensor.
- .21 All data transmissions, including the analogue value, between the smoke

sensors and the control panel shall be digitally transmitted and incorporate parity and checksum digital data checks of each transmission.

- .22 An operator from the control panel, having a proper access level, shall have the ability to:
 - .1 Manually access and print the following information for each sensor in a report format that can be easily understood by the user:
 - .1 Primary Status
 - .2 Device Type
 - .3 Present Average Value
 - .4 Present Sensitivity Selected
 - .5 Highest Peak Detection Values
 - .6 Sensor Chamber Status (Normal, Almost Dirty, Dirty, Excessively Dirty)
 - .2 Manually control the following of each sensor:
 - .1 Clear Peak Detection Values
 - .2 Enable or Disable the Point
 - .3 Clear Verification Tally
 - .4 Control a Sensor's Relay Driver Output
- .23 It shall be possible to program the control panel to automatically change the sensitivity settings of each sensor based on time-of-day and day-of-week.
- 2.4 Addressable Manual Alarm Stations
 - .1 Manual alarm stations shall be addressable, single action, non-coded, semi-flush mounted type. Pull stations shall be break-glass style. Contacts are to activate when handle is pulled down.
 - .2 Addressable pull station electronics shall be mounted to the back plate of the station. The station's address will be set at the time of installation. Device addressing shall be accomplished by either an electrical or mechanical means.
 - .3 Where noted on drawings, stations are to be equipped with tamperproof guard equal to Stopper II Cat. # STI-1100.
- 2.5 Intelligent Detectors – General Operation
 - .1 Addressable devices shall use simple to install and maintain decade,

- numbered 0 to 9, address switches. Detectors that have expanded addressing will have decade switch numbered from 0 to 15 for the most significant digit to allow detector addressing from 1 to 250.
- .2 Device addressing shall be accomplished by either an electrical or mechanical means.
 - .3 Detectors shall be in Telligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel signaling line circuits.
 - .4 Addressable smoke detectors shall provide dual alarm and power/polling L.E.D.s. Both L.E.D.s shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both L.E.D.s shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected, if required, the L.E.D. flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm L.E.D..
 - .5 The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity shall be automatically adjusted by the panel on a time-of-day basis.
 - .6 Using software in the F.A.C.P., detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance.
 - .7 The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base shall include a sounder base with a built-in (local) sounder rated at 85 D.B.A. minimum, a relay base and an isolator base designed for Style 7 applications.
 - .8 The detectors shall provide at test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
 - .9 Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
 - .10 Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the F.A.C.P. based on real-time measured values. The F.A.C.P. software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the F.A.C.P. program and allowing the system operator to view the current analog value of each detector.

- .11 Detectors shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. L.E.D.s shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
- .12 Addressable devices shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. L.E.D.(s) shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
- .13 The sensors shall be of a low profile design and U.L.C listed for both ceiling and wall mount applications.
- .14 Automatic smoke sensors shall be equipped with a dust cover, which shall be removed at the time of verification to prevent dust and dirt entering the smoke chamber during construction.
- .15 A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100 percent of the alarm threshold.

2.6 Intelligent Multi-Detector

- .1 The intelligent multi-detector shall be an addressable device, which is designed to monitor photoelectric, ionization, and thermal technologies in a single sensing device. This detector shall utilize advanced electronics which react to smaller products of combustion found in fast flaming fires (ionization), slow smoldering fires (photoelectric), and heat (thermal) all within a single sensing device.
- .2 The multi-detector shall include two bicolour L.E.D.s, which flash green in normal operation and turn on steady red in alarm.
- .3 Detectors are to be provided with relay base where noted on the drawings.
- .4 Separately mounted photoelectric ionization and heat detectors in the same location are not acceptable alternatives.

2.7 Fixed Temperature Heat Detector

- .1 These heat detectors shall have a low mass thermistor heat sensor and operate at a fixed temperature. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. The heat detector shall have a nominal alarm point rating of 57 degrees Celsius(135 degrees Fahrenheit). The heat detector

shall be rated for ceiling installation at a minimum of 21.3 meters (70 feet) centres and be suitable for wall mount applications.

2.8 Fixed Temperature/Rate of Rise Heat Detector

- .1 These heat detectors shall have a low mass thermistor heat sensor and operate in a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 57 degrees Celsius (135 degrees Fahrenheit) and a rate-of-rise alarm point of 9 degrees Celsius (15 degrees Fahrenheit) per minute. The heat detector shall be rated for ceiling installation at a minimum of 21.3 meters (70 feet) centres and be suitable for wall mount applications.

2.9 Photoelectric Smoke Detectors

- .1 The intelligent photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging, and humidity. The photo detector shall be rated for ceiling installation at a minimum of Soft (Olin) centres and be suitable for wall mount applications.
- .2 The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0 percent to 3 percent. The photo detector shall be suitable for operation in the following environment:
 - .1 Temperature: 0 degrees Celsius to 49 degrees Celsius(32 degrees Fahrenheit to 120 degrees Fahrenheit)
 - .2 Humidity: 0-93 percent R.H., no-condensing
 - .3 Elevation: no limit
- .3 Detectors are to be provided with relay base where noted on the drawings.

2.10 Standard Detector Mounting Bases

- .1 Provide standard detector mounting bases suitable for mounting on North American 1-gang, 85 millimeters (3-1/2 inches) or 100 millimeters (4 inches) square box. The base shall, contain no electronics, support all

detector types and have the following minimum requirements:

- .1 Removal of the respective detector shall not affect communications with other detectors.
- .2 Terminal connections shall be made on the room side of the base. Bases which must be removed to gain access to the terminals shall not be acceptable.

2.11 Audible/Visual Signal Devices

- .1 Mini Horns: flush mounted temporal mini horn, 24 V.d.c. operation, selectable HIGH/LOW setting 94.5 d.B.A. (high)/89.8 d.B.A. (low) at 3 meters (10 feet), white or red coverplate, F.M. and U.L.C. listed. Suitable for mounting on a single gang box.
- .2 Strobe: semi-recessed, 24 V.d.c. operation, complete with selectable 15/30/75/110 candela output (unless otherwise noted set at 15 cd), synchronized strobe, red finish, F.M. and U.L.C. listed. Suitable for mounting on a single gang box.
- .3 Mini Horn/Strobe: flush mounted temporal combination mini horn/strobe, 24 V.d.c. operation, selectable HIGH/LOW setting 94.5 d.B.A. (high) / 89.8 d.B.A. (low) at 3 meters (10 feet) selectable 15/30/75/110 candela output (unless otherwise noted set at 15 cd), synchronized strobe white or red coverplate, FM and U.L.C. listed. Suitable for mounting on a single gang box.

NOTES:

- .1 Signal devices with integral strobe lights in high abuse areas (i.e. gymnasium, change rooms, etcetera) must be provided with protective wireguards.
- .2 Any surface mounted signal devices must be provided with suitable backboxes supplied by the manufacturer.
- .3 Provide synchronization modules to suit signal devices (if required by manufacturer).
- .4 Set signal devices in classrooms to LOW setting.

2.12 Graphic Display (Passive)

- .1 The colour graphic display shall be computer printed on archival film. The film must be dimensionally stable and the inks utilized shall offer U.V. protection with no fade characteristics. The graphic image shall be electronically stored for easy access and future alterations. Electronic version of the floor plan is available from the Consultant for an agreed fee.
- .2 The building outline and zone area designations shall be depicted by a

blank border and clearly labelled with description and zone number. A "You Are Here" notation shall be shown in red at the annunciator location and proper directional orientation must be observed.

- .3 The computer-printed film shall be placed on a 3 millimeters (1/8 inches) thick white matte acrylic sheet and be protected by a 1/8 inches thick clear acrylic outer shield. The active display shall come complete with window to view the graphic display L.E.D.'s.
- .4 The annunciator must be flush mounted at the location indicated and keyed similar to control panel.
- .5 In addition to the above, the graphic display shall be provided with:
 - .1 Green power on L.E.D.
 - .2 Yellow system trouble L.E.D.
 - .3 Red system alarm L.E.D.
- .6 The annunciator shall be complete with an L.C.D. display indicating alarm, supervisory and trouble conditions complete with status of all system conditions.

2.13 Intelligent Modules – General Operation

- .1 The modules shall have a minimum of 2 diagnostic L.E.D.'s mounted behind a finished coverplate. A green L.E.D. shall flash to confirm communication with the loop controller. A red L.E.D. shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes, which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:
 - .1 Temperature: 0 degrees Celsius to 49 degrees Celsius (32 degrees Fahrenheit to 120 degrees Fahrenheit)
 - .2 Humidity: 0-93 percent R.H., non-condensing

2.14 Monitor Module

- .1 The monitor modules shall have the following operating characteristics:

A flashing L.E.D. indicates that the module is in communication with the control panel. The L.E.D. latches steady on alarm (subject to current limitations on the loop).
- .2 The monitor modules shall have the following features:

Nominal operating voltage:	15 to 32 V.D.C.
Maximum current draw:	5.1 m.A. (L.E.D. on)

Average operating current:	400 u.A. (L.E.D. flashing)
EOL resistance:	47K ohms.
Temperature range:	0 degrees Celsius to 49 degrees Celsius(32 degrees Fahrenheit to 120 degrees Fahrenheit)
Humidity range:	10 percent to 93 percent noncondensing
Dimensions:	114.3 millimeters (4.5 inches) high by 101.6 millimeters (4 inches) wide by 31.75 millimeters (1.25 inches) deep. Mounts to a 101.6 millimeters (4 inches) square by 53.975 millimeters (2-1/8 inches) deep box.

2.15 Isolator Module

- .1 Fault isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an S.L.C. loop. The fault isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the S.L.C. loop. If a wire-to-wire short occurs, the fault isolator module shall automatically open-circuit (disconnect) the S.L.C. loop. When the short circuit condition is corrected, the fault isolator module shall automatically reconnect the isolated section of the S.L.C. loop.

The fault isolator module shall not require any address-setting, and its' operations shall be totally automatic. It shall not be necessary to replace or reset a fault isolator module after its normal operation. The fault isolator module shall mount in a standard 10.16 centimeters (4 inches) deep electrical box, in a surface-mounted backbox, or in the fire alarm control panel. It shall provide a single L.E.D. which shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

2.16 Control Module

- .1 Addressable control modules shall be provided to supervise and control the operation of one conventional N.A.C.s of compatible, 24 V.D.C. powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contact relay.
- .2 The control module NACs may be wired for Style Z. or Style Y. (Class A/B) with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form-C.) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to ensure that 100 percent or all auxiliary relay or N.A.C.s may be energized

at the same time on the same pair of wires.

- .3 The control module shall be suitable for pilot duty applications and rate for minimum of 0.6 Amps at 30 V.D.C..

2.17 Sprinkler and Supervised Valve Connections

- .1 Sprinkler and standpipe system contacts shall be provided by Division 21 but connected into the fire alarm system by this Division.

2.18 U.L.C. Monitoring

- .1 Obtain the services of an approved Fire Alarm monitoring company to obtain a U.L.C. certificate for monitoring of Fire Alarm system.
 - .1 Approved Fire Alarm monitoring company: Alarm Systems
- .2 Provide monitoring system as required by code. Enclosures to be properly labelled and to be coloured red.
- .3 Provide redundant lines of communication for monitoring (one data and one phone line)
- .4 Provide security style control panel to monitor minimum of four points from the fire alarm control panel:
 - .1 Fire Alarm
 - .2 Fire Alarm Trouble
 - .3 Fire Alarm Supervisory
 - .4 Fire Alarm Tamper (Door Open)

2.19 System Wiring

- .1 The system wiring must be F.S.A. rated in conformance with the Electrical Safety code to suit the type of installation.
- .2 Wiring shall be minimum #18 AWG twisted shielded pair in conduit. "Securex 2" armoured cable will be permitted to be used for "drops" to devices on accessible ceilings.
- .3 As indicated on system riser diagram initiating device wiring shall be run in a loop with a home run from the last device to the control panel (Class 'A' configuration).
- .4 Signal wiring is to be cross connected in a Class 'A' configuration.
- .5 Install isolator modules in service rooms no higher than 2.4 meters above finished floor. Provide location of these devices at the time of shop drawing submission.

- .6 These are the basic wiring requirements for system operation. Prior to tender close manufacturer and contractor are to confirm all necessary wiring specifications and requirements.

Part 3 - Execution

3.1 Installation

- .1 The entire system shall be installed in accordance with C.A.N./U.L.C.-S524 (latest edition) and approved manufacturers manuals and wiring diagrams. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the Electrical Safety Code, approved by local authorities having jurisdiction for the purpose, and shall be installed in dedicated conduit throughout.
- .2 Install main control panel and connect to A.C. power supply.
- .3 Locate and install manual alarm stations and connect to alarm circuit wiring.
- .4 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 meter (39 inches) of air outlets. Maintain at least 600 millimeters (24 inches) radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .5 Connect alarm circuits to main control panel.
- .6 Locate and install signal devices and connect to signalling circuits.
- .7 Connect signalling circuits to main control panel.
- .8 Install remote annunciator panels and connect to annunciator circuit wiring.
- .9 Locate and install door releasing devices.
- .10 Locate and install remote relay units to control fan shut down.
- .11 Sprinkler system: wire alarm and supervisory switches and connect to control panel.
- .12 Connect fire suppression systems to control panel.
- .13 The manufacturer and electrical contractor are to allow in their tender the cost of additional devices noted below to be installed and verified in locations as directed by the Consultant. The cost of the additional devices shall include remobilization (if required), verification and labour/material based on 5000 millimeters of conduit and wire.

Note: This installation and verification will be occurring after the audibility testing is complete.

1. Smoke Detectors – Five
2. Heat Detectors – Five
3. Pull stations – Three
4. Horns – Five
5. Strobes – Five
6. Combination Horn/Strobes – Five
7. Signal DB reducers – Ten
8. Relay Module – One
9. Isolator Module – Three

3.2 Field Quality Control

- .1 The system shall be installed and fully tested under the supervision of trained manufacturer's representative. The system shall be demonstrated to perform all the functions as specified.

3.3 Acceptable Installer

- .1 The fire alarm/life safety system specified herein shall be installed by an Authorized Electrical Contractor who is C.F.A.A. Certified.

3.4 Examination

- .1 Prior to the commencement of any of the work detailed herein, an examination and analysis of the area(s) where the Fire Alarm/Life Safety System and all associated components are to be installed shall be made.
- .2 Any of these area(s) which are found to be outside the manufacturer's recommended environments for the particular specified products shall be noted on a Site Examination Report which shall be given to the Building Owner's Representative, and the Consultant.
- .3 Any shorts, opens, or grounds found on existing wiring shall be corrected prior to the connection of these wires to any panel component or field device.

3.5 Demonstration

- .1 Each of the intended operations of the installed Fire Alarm/Life Safety System shall be demonstrated to the Building Owner's Representative and the Consultant.

3.6 System Test

- .1 Perform tests in accordance with Section 26 05 01 and C.A.N./U.L.C.-

S537 (latest edition) Standard for the Verification of Fire Alarm Systems.

- .2 Fire Alarm System:
 - .1 Test each device and alarm circuit to ensure noted devices transmit alarm to control panel and actuate general alarm ancillary devices.
 - .2 Check annunciator panels to ensure zones are show correctly.
 - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.
 - .4 Class A Circuits:
 - .1 Test each conductor on all circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near middlemost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
 - .2 Test each conductor on all circuits for capability of proving alarm signals during ground-fault condition imposed near middlemost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
- .3 The control panel shall continuously perform as automatic self-test routine on each sensor, which will functionally check the sensor electronics and ensure the accuracy of the valves being transmitted to the control panel.
- .4 Automatic testing will occur at a rate of one sensor every four minutes.
- .5 The sensor's average analogue value is the average of the last 2000 recorded analogue entries of its chamber.
- .6 Any sensor that fails this test shall indicated a 'SELF-TEST ABNORMAL' trouble condition with the sensor's address at the control panel.
- .7 The system shall automatically indicate when an individual sensor needs cleaning. When the sensor's average value reaches a predetermined value, a 'DIRTY SENSOR' trouble condition shall be audibly and visually indicated at the local control panel for that sensor. IF a 'DIRTY SENSOR' indication is left unattended and its average value increases to a second predetermined value, an 'EXCESSIVELY DIRTY SENSOR' trouble condition shall be indicated at the local control panel for that sensor. To prevent false alarms, these 'DIRTY' conditions shall in no way decrease the amount of smoke obscuration necessary to generate an alarm condition.
- .8 An operator having a proper access level, shall have the capability to

manually access the following information from the control panel:

- .1 Primary Status
- .2 Device Type
- .3 Present Average Value
- .4 Present Sensitivity Selected*
- .5 Highest Peak Detection Values (H.V.P.) *
- .6 Sensor Range (Normal, Dirty, Excessively Dirty)

* Values shall be in 'percent of smoke obscuration' format so that no interpretation is required by the operator.

3.7 Audibility Testing

.1 Audibility Testing:

- .1 The contractor is to coordinate an two (2) audibility tests prior to occupancy of the facility. The test is to be performed by the representatives of the fire alarm manufacturer in the presence of the Consultant. The test report is to be in chart form indicating:
 - .1 Project
 - .2 Date of test
 - .3 Room name and number
 - .4 Ambient dB level
 - .5 Alarm dB level
 - .6 Name of testing technician
- .2 The test results are to be submitted to the Consultant for review prior to issuing to Owner's representatives and/or authorities having jurisdiction. Second audibility test to be conducted after initial test results have been reviewed and remediation confirmed by Consultant, if required.

End of Section

Part 1 - General

1.1 Shop Drawings

- .1 Submit 6 sets of shop drawings to the electrical contractor for submission to the consultant for review.
- .2 Submit shop drawings of materials and equipment to be supplied on the project. Submission shall include manufacturer, dimensions, appearance and specifications.
- .3 Submit shop drawings for jacks, copper cable, faceplates, patch panels, racks, cable managers, patch cords, etcetera.

1.2 Product/Maintenance Data

- .1 Submit product/maintenance data for each system for inclusion in maintenance manual conforming to Section 16010.

1.3 Scope

- .1 The scope of this Section will include the following system.
 - .1 Voice/data network installations.

Part 2 - Products

2.1 Voice/Data Network Installations

- .1 The scope of work for this system shall be as follows:
 - .1 This work includes Category 6 voice and data cabling.
 - .2 Copper services between the communication rooms and a voice outlet shall consist of the one plenum rated Category 6 compliant four-paired unshielded twisted pair cable, and one plenum rated Category 6 compliant four-paired unshielded twisted pair cables for a data outlet.
 - .3 Horizontal data cables shall be terminated in Cat. 6 jacks at the workstation end and in Cat. 6 patch panels at the communications closet end.
 - .4 Patch panels shall be mounted in racks(s) and/or cabinets as specified.
 - .5 Horizontal voice cables shall be terminated in Cat. 6 jacks at the workstation end and in BIX1A4 punch down blocks in the main telecommunication room. Punch down blocks shall be mounted in BIX10A complete with designation strips and labels.

- .6 A cable management system has been provided in the corridors for all voice and data cables. Outlets boxes and conduits have been provided at each outlet location. Conduits extend from the outlet box to the corridor and terminate adjacent to the cable management system.
- .7 Additional conduits have been provided to complement the cable management system. Refer to the floor plans.
- .8 Supply and install a complete voice and data structured cabling system as outlined in the tender drawings and specifications.
- .9 The installation of patch cords at the work station end shall be by this contractor. The length of the patch cords shall be as follows: 50% 4ft. long and 50% 6ft. long.
- .10 The local area network system must be "protocol neutral" and provide users access into a variety of resources from any location within the building. An Ethernet backbone shall be utilized for the system with intelligent switching HUBS coordinating and managing data flow. The wiring configuration is based on a "physical star" topology in which cabling runs emanate in a radial pattern from the telecom rooms in which the intelligent switching equipment is located.
- .11 The Contractor shall provide cabling from main Hub Room to each location shown on drawings for future wireless access points. Contractor shall coil 6.1 meters (20 feet) of cable in ceiling space at location to allow for relocation as required by Owner's I.T. personnel. Identify each cable in main Hub Room.
- .12 All work performed must conform to the latest version of the applicable codes, standards and regulations of authorities having jurisdiction.
 - .1 A.N.S.I./T.I.A./E.I.A.-568-B Telecommunications Cabling Standard
 - .2 A.N.S.I./T.I.A./E.I.A.- 569 Pathway and Space
 - .3 I.S.O.-11801 Generic Cabling for Customer Premises
 - .4 B.I.C.S.I. Telecommunications Distribution Methods Manuals
 - .5 C.S.A. T530 Commercial Building Standard for Telecommunication .6

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|-----|------------------------|---|
| | | Pathways and Spaces
(ANSI/T.I.A./E.I.A.-569-A) |
| .6 | C.S.A. T528 | Administration Standards for
the Telecommunications
Pathway and Spaces.
(ANSI/T.I.A./E.I.A.-606) |
| .7 | C.S.A. T527 | Commercial Building
Grounding and Bonding
Requirements for
Telecommunications.
(ANSI/T.I.A./E.I.A.-607) |
| .8 | C.S.A. C22.1 | Canadian Electric Code Part 1
- Ontario Electrical Safety
Code |
| .9 | C.S.A. C22.2 No. 214 | Communications Cables. |
| .10 | C.S.A. C22.2 No. 232-M | Fibre Optic Cables. |
| .11 | O.B.C. | Ontario Building Code |
- .2 The Owner has standardized on Panduit for the Structured Cabling System. No alternative will be accepted, except where noted. Bidders must identify alternate products with their bids, including Manufacturer part numbers. No alternates will be considered unless they are clearly identified in the tender submission.
- .3 The successful bidder will be responsible for complete storage, handling, delivery and installation of all materials.
- .4 The Telecommunications Contractor will be responsible for cleanup related to his/her scope of work. The Contractor will be excepted to remove all debris related to his work on a daily basis. Failure to comply will expose the Contractor to back-charges from the General Contractor or the Owner for clean-up on the Contractor's behalf.
- .5 The Contractor will have only tradesmen who are fully qualified and experienced in the installation of a certified communications cabling system and wireless network systems.
- .6 The successful Contractor will be required to submit the following documents, prior to being awarded the contract:
- .1 Current training and certification status by the specified manufacturer of the Cabling System.

- .2 Proof of R.C.D.D. on staff. Registration information must be submitted with the shop drawings.
- .3 Experience in construction projects for related projects.
- .4 Experience in construction projects working for General Contractors.
- .5 Experience on troubleshooting and problem solving in data communication networks.
- .7 At least one member of the Contractor's project team must hold a current R.C.D.D. accreditation. The R.C.D.D. will be responsible for quality control and certification of the project.
- .8 A Project Manager and Foreman will be assigned to the project within 3 working days of contract award. These personnel will not be removed from the project without the prior consent of the Board's Representative.
- .9 The Contractor must comply with all job-site union requirements for the duration of the project.
- .10 The contractor will not subcontract any portion of the work, unless authorized in writing by the Board's Representative.
- .11 The Contractor must comply with all requirements of the Occupational Health and Safety Act, without exception.
- .12 Outlets where noted shall be single gang flush mounted in wall or surface raceways.
- .13 Outlets if unwired are to be provided with blank coverplates to suit related sections of this specification.
- .14 A single manufacturer shall manufacture the specified cable and channel components. The manufacturer shall warrant the cable, channel components, and applications for a period as specified in the Warranty section.
- .15 Category 6 Cable
 - .1 Cable shall be 4 pair, 24 A.W.G. solid bare annealed copper conductors.
 - .2 The jacket shall be printed with TRU-Mark™ 1000 feet to 0 feet marking system, C.M.P. (F.T.-6) rated with blue outer sheath for data and white outer sheath for voice.
 - .3 Shall be suitable for use indoor, riser or plenum, and horizontal applications.

- .4 Category marking shall be printed every one foot.
- .5 Shall be independently verified to comply with T.I.A./E.I.A. 568-B.2 or T.I.A./E.I.A. 568-A-5.
- .6 Shall be packaged in a way protecting the cable.
- .7 Cable shall be A.N.S.I./T.I.A./E.I.A.-568-B-.2 and I.S.O./I.E.C. 11801 category 6 compliant.
- .8 Attenuation shall be measured in accordance with T.I.A./E.I.A. 568B.2 and shall be maximum of 22.0 d.B. at 100 M.Hz.
- .9 Cable shall be exhibit positive P.S.A.C.R. above 200 M.Hz.
- .10 Cable shall be tested & characterized to 350 MHz.
- .11 Cable shall be U.L. LISTED.
- .12 An I.S.O. 9002 Certified Manufacturer shall make the Cable.
- .13 Cable shall exhibit the following transmission characteristics:

Frequency M.Hz.	NEXT dB	ELFEXT dB	Attenuation (d.B.)	Return Loss (d.B.)
1.0	70	64	2.0	20.0
4.0	61	52	4.1	23.0
10.0	55	44	6.5	25.0
16.0	52	40	8.2	25.0
20.0	50	38	9.3	25.0
31.25	47	34	11.7	23.6
62.5	43	28	17.0	21.5
100.0	40	24	22.0	20.1

- .14 The “Structured Cabling Plan” is an end to end solution which includes the data communication outlet and patch cord at the workstation and the patch panel, patch cords and racks at the HUB room.
- .15 Approved Manufacturers:
 Panduit Cat. # PUP6X04BU-U (DATA)
 Panduit Cat. # PUP6X0WH-U (DATA)

.16 Faceplates

- .1 Faceplates shall be U.L. Listed C.S.A. Certified
- .2 Faceplates shall be constructed of stainless steel.
- .3 Faceplates shall be 2.75 inches Wide by 4.5 inches High (69.8 millimeters by 114.3 millimeters) for single gang and 4.5 inches by 4.5 inches (114.3 by 114.3 millimeters) double gang.
- .4 Faceplates shall be available to mount one, two, three, four, or six jacks in a single gang, and six or nine jacks in double gang configuration.
- .5 Two and three-port faceplates shall be available with thermal ink transfer stenciled port indications for voice and data or voice.
- .6 Faceplates shall provide for T.I.A./E.I.A. 606 compliant station labeling.
- .7 All horizontal data cable installed in surface raceway shall be terminated with jacks as specified following in a 3-port "DECO adapter" plate on the raceway outlet location. Provide plate to match selected raceway colour and provide blanks in ports not used. Surface faceplates on top of the raceway will not be permitted.
- .8 Approved Manufacturers:
 - .1 Panduit Cat. # C.F.P. Series

.17 Category 6 Modular Jack (Horizontal Cabling)

- .1 Jacks shall be 8-position un-keyed.
- .2 Each jack shall be individually constructed unit and shall snap mount in an industry standard manufacturer's opening (.760 inches by .580 inches).
- .3 Jack housings shall be high impact 94 V.0. rated thermoplastic.
- .4 Jacks shall have an operating temperature range of minus 10 degrees Celsius (14 degrees Fahrenheit) to 60 degrees Celsius (140 degrees Fahrenheit).
- .5 Modular jack contacts shall accept a minimum of 2500 plug insertions without degradation of electrical or mechanical performance.
- .6 Contacts shall maintain a minimum vertical deflection force of 110 grams.

- .7 Modular jack contacts shall be formed flat for increases surface contact with mated plugs. These contacts shall be arranged on the PC board in 2 staggered arrays of 4 maximize contact spacing and minimize crosstalk.
- .8 Modular jack contacts shall be constructed of Beryllium copper for maximum spring force and resilience.
- .9 Contact Plating shall be a minimum of 50 micro inches of gold in the contact area over 50 micro-inches of nickel.
- .10 Jack termination shall be industry standard insulation displacement contact, integral to the jack housing, laid out in 2 arrays of 4 contacts, positioned at angles to minimize the bending of terminated cables.
- .11 Jacks shall utilize a paired punch down sequence. Cable pairs shall be maintained up to the I.D.C., terminating all conductors adjacent to its pair mate to better maintain pair characteristics designed by the cable manufacturer.
- .12 Insulation displacement contacts shall utilize tin lead plated (60 percent tin per 40 percent lead) phosphor bronze.
- .13 Jacks shall terminate 22-26 A.W.G. standard or solid conductors.
- .14 Jacks shall terminate insulated conductors with outside diameters up to .050 inches.
- .15 Jacks shall be compatible with single conductor impact termination tools (if applicable).
- .16 Jacks shall include grey translucent wire retention stuffer caps to hold terminated wires in place while allowing conductors to be viewed in the I.D.C. housing. Stuffer caps may also be used for wire termination with parallel jaw pliers.
- .17 Jacks shall be compatible with E.I.A./T.I.A. 606 color code labeling and accept snap on icons for identification or designation of applications.
- .18 Jacks shall be designed for 100 Ohm U.T.P. cable termination.
- .19 Jacks shall be U.L. VERIFIED for T.I.A./E.I.A. Component compliant Category 6e electrical performance.
- .20 Jacks shall be U.L. LISTED 1863 and C.S.A. certified.
- .21 Jacks shall be manufactured by an I.S.O. 9002 Registered Manufacturer.

- .22 Jacks shall exhibit values, which exceed the following in a Channel Performance (ga) based on worst case in a 4-connector model verified at TEL Laboratories.

Frequency M.H.z.	ATTEN d.B.	PSNEXT d.B.	NEXT d.B.	ELFEXT d.B.	PSELFEXT d.B.	Return Loss d.B.
10	6	55.6	57.7	45.5	43.6	28.7
62.5	15	41.8	44.8	33.1	29.4	20.7
100	18.3	37	40.3	27	25.4	18.5
155	23.7	33.9	36.7	22.7	22	16.6
250	31.3	30.7	33.4	21.4	17.6	16.2

- .23 Jacks shall exhibit a propagation delay of less than 5 ns.

- .24 Jacks shall exhibit a delay skew of less than 1.25 ns.

- .25 Approved Manufacturer:

Data: Panduit Cat. #CJ688T3BU

Voice: Panduit Cat. #CJ688T3IW

- .18 Category 6 Patch Panels

- .1 Panels shall be made of black anodized .090 inch aluminum in 24 and 48-port configurations.
- .2 Panels shall accommodate 24 ports for each rack mount space or "U" (1U = 44.5 millimeters [1.75 inches]).
- .3 Panels shall be manufactured with a rolled-edge at the top and bottom for stiffness.
- .4 Panels shall have modular jacks employing staggered array contacts with a flat "hairpin" design made of Beryllium copper with a minimum 50-micro-inch gold plating on contact surfaces over 50-100 micro-inch of nickel compliant with F.C.C. part 68.
- .5 Panels shall be available in both T568A and T568B wiring schemes.
- .6 Panels shall be equipped with a termination made of fire retardant U.L. 940V0 rated thermoplastic and tin lead solder plated I.D.C.

- .7 Panel circuit boards shall be fully enclosed front and rear for physical protection.
- .8 Panels shall have port identification numbers on both the front and rear of the panels. The port identification numbers on the panel front shall be located so as to minimize obstruction by patch cords.
- .9 Panels shall have optional rear cable support bar for strain relief, which shall clip to the rear of the patch panel.
- .10 The panel front shall have two raised panel identification label fields to accept ½ foot label inserts.
- .11 Panels shall have self-adhesive, clear label holders and white designation labels provided with the panel for each 8 port adapter.
- .12 Panels shall provide wiring identification and colour code and maintain a paired punch down sequence that does not required the overlapping of cable pairs.
- .13 Panels shall terminate 22-26 A.W.G. solid conductors, maximum insulated conductor outside diameter 0.050 inches.
- .14 Panels shall be A.N.S.I./T.I.A./E.I.A.- 568-A- and I.S.O./I.E.C. 11801 Category 6e compliant.
- .15 Panels shall be U.L. VERIFIED for T.I.A./E.I.A. Category 6e performance.
- .16 Panels shall be U.L. LISTED 1863 and C.S.A. certified.
- .17 Panels shall be made by an I.S.O. 9002 Certified Manufacturer.
- .18 Panels shall exhibit a Component NEXT loss of at least the following:

Frequency M.H.z.	NEXT d.B.	FEXT d.B.	Attenuation d.B.
1.0	81.7	82.0	.01
4.0	70.9	69.6	.01
8.0	68.8	64.1	.01
10.0	67.3	62.1	.01
16.0	63.4	58.1	.02
20.0	61.5	56.1	.02
25.0	59.7	54.2	.03

31.25	57.8	52.2	.03
62.5	51.9	45.1	.05
100.0	47.1	68.9	.09

.19 Approved manufacturers:

Panduit 24 PORT Cat. #DP24688WGP
48 PORT Cat. #DP48688WGP

.19 Voice Terminations

.1 All voice cables shall be terminated in the main telecommunication backboard in the Hub Room in BIX1A4 connectors mounted in BIX10A mounts. Supply and install all necessary accessories, designation strips, labels, D-rings, etcetera, for a complete installation.

.20 Patch Cords – U.P.T. (Category6)

- .1 Copper patch cords shall be 100% tested to Category 6 A.N.I.S./T.I.A./E.I.A.-568-A-4 specifications.
- .2 Cord wiring shall be compatible with T568a and T568B wiring standards.
- .3 Patch cords shall have yellow jacket.
- .4 Provide in quantities as stated in the scope portion of this specification.
- .5 Acceptable manufacturers:
Panduit Cat. # UTPCTGXYL (length as previously specified)

.21 Labels

- .1 Labels shall be mechanically printed. Hand written labels are not acceptable.
- .2 Supply and install self laminated labels at both ends of each cable. Cables shall be labeled as follows:
“ROOM #/PATCH PANEL LETTER/PORT#”
EXAMPLE: A cable in room 201, patch panel #A, port #12 shall be designated as 201/A/12.
NOTE: Labeling must be confirmed with Owner’s Representative.

- .3 Supply and install labels at each outlet location. Labels shall be affixed to the faceplate on the space provided by the Manufacturer.
- .4 Workstation faceplates shall be designated in an identical duplicate manner as cables.
- .5 Patch panel ports shall be identified in simple numeric form.
- .6 Patch cords shall be identified at both ends in simple numeric form, not necessarily corresponding to port numbers.
- .7 All cable and workstations shall be recorded in a hard copy "CABLE IDENTIFICATION LOG" which is to be handed over to Manager of Computer Services after cable testing and certification is complete.

NOTE: The faceplate identification numbers/tags MUST be added to the electronic versions of the floor plans. BOTH a digital and paper copy of this plan must be submitted. This will be considered part of the AS Built contracts closeout submittals. The electronic version of the floor plan will be provided in an acceptable ACAD format by the Consultant.

.22 Data wiring termination rack:

- .1 All racks for this project are to be complete with the following features:
 - .1 Free standing, floor mounted.
 - .2 Standard 475 millimeters (19 inches) module compatible.
 - .3 44u or rack mounting space.
 - .4 Maximum dimensions: 550 millimeters (22 inches) Wide by 300 millimeters (12 inches) Deep by 2125 millimeters (85 inches) High.
 - .5 Each rack shall come complete with vertical cable managers installed (one mounted on each side). The vertical cable managers must run the full height of the rack mounting space and provide a minimum of 125 millimeters (5 inches) by 150 millimeters (6 inches) of cable management space on the outside of ganged racks and one 125 millimeters (5 inches) by 188 millimeters (7.5 inches) (minimum) in between each pair of racks. The vertical cable manager must have hinged front doors and back and side cut outs to allow for Patch Cords. It must also have lancets along the back of the cable manager to allow for the fastening of the horizontal cable to the outside of the manager itself.

- .6 Each rack shall come complete with a hinged overhead cable manager installed, dimensions 100 millimeters (4 inches) by 150 millimeters (6 inches); both ends of the overhead management are to be completed with end caps.
 - .7 For all racks the Cabling Contractor is to supply and install horizontal cable managers (compatible with standard 475 millimeters (19 inches) equipment racks). The horizontal cable managers are to be hinged at the front with vertical access to the patch panels above and below. Each horizontal cable manager is to be 2-rack unit (2U) in height. One chimney stack per rack minimum. Supply a total of 1 horizontal cable manager per 48 port patch panel plus 1 additional horizontal cable manager per rack.
 - .8 Each rack is to come complete with one vertical power bar. Each power bar is to have 10 outlets (minimum) and surge protection. The power cord must be a minimum 1.8 meters (6 feet) in length to reach up to the overhead ceiling where it will plug into a 15 Amp receptacle (supplied by others). The power bars are to be non-switched and have 15 Amp twist lock receptacles, they are to be mounted on the left side of the rack at the back.
 - .9 In all cases racks and components are to be black.
 - .10 Approved manufacturers:
 - RF MOTE Cat. #RFM-1944-RB 19" standing rack complete with
 - RFM-RVCM - vertical managers
 - RFM-119 HCT- top managers
 - RFM-HCTE - ends caps
 - RFM-76-PBVT - power strip
 - RFM-192D-HCM-TD - horizontal mangerApproved equals:
 - Middle Atlantic
 - Panduit CMR Series
- .23 Grounding and Bonding
- .1 The grounding and bonding requirements of this project shall meet C.S.A. T527 and it is intended to work in concert with the cabling

topology and installed in accordance with C.S.A. T530 (telecommunication pathways and spaces standard).

- .2 A copper ground busbar will be established in each telecommunication room provided by the selected Electrical Contractor. Establish a communications ground that is continuous and permanent through all the telecommunication rooms.
- .3 Ground all racks, cabinets and pathways to the telecommunication grounding system using green #6 A.W.G. insulated stranded copper ground wire. This grounding is to be provided by the Electrical Contractor.

Part 3 – Execution

3.1 Voice/Data Network Installations

- .1 Cabling Contractor is to adhere to all Standard, regulations and documents listed following.
- .2 All products installed must meet or exceed all local, provincial and federal building, fire, health, safety and electrical codes.
- .3 The responsibility of the network sub-contractor is to include but not be limited:
 - .1 Supply and installation of computer cabling to every outlet as noted on the drawings.
 - .2 Termination of computer cabling at outlet and distribution panel.
 - .3 Supply and installation of device faceplates in surface raceways and/or flush outlet boxes.
 - .4 Supply and installation of fibre optic cable.
 - .5 Supply and installation of computer network rack and distribution panels required for a complete and operational system. Interface server computer and hubs will be supplied complete by the Owner.
 - .6 Testing in conformance with noted procedures.
 - .7 Labeling of outlet faceplates and associated port on distribution panel. An “As Built” floor plan “outlets addresses” must be provided at the completion of the project.
- .4 Co-ordinate work with Owner’s Computer Services personnel.
- .5 The Owner’s Network Integrator must be present on site to witness and coordinate the required system testing. The cabling contractor and the Network Integrator must together perform a job walk through upon

completion of testing, together sign the cabling test report to verify that network cabling is properly installed and performs to acceptable Owner's Standard.

- .6 The Electrical Contractor is to include all costs of the network sub-contractor in his tender. The Electrical Contractor must sub-contract and coordinate all work of the network sub-contractor.
- .7 General installation practices shall be as follows:
 - .1 Supply and install cabling to locations as detailed on floor plan(s). The Cabling Contractor shall use the cabling support system (support by others) to distribute the cables throughout the facility. Where the cables leave the cable support system and extend to the termination point they shall use the conduit provided or cable management system. Any horizontal exposed cable must be installed in surface raceways equal to Wiremold Series 500/700.
 - .2 All Cables and components to be installed and terminated in accordance with C.S.A., A.N.S.I./E.I.A./T.I.A. -568 and its' Amendments as well as UL Guidelines. Particular attention must be given to maintaining the integrity of the pair twists, bend radius and ensuring proper distance is kept from fluorescent light fixtures, electrical cables or any other source of E.M.I.
 - .3 Ensure A.N.S.I./E.I.A./T.I.A. -568A installation practices are followed. Cables are to be combed and bundled in a neat and organized manner. The Owner's Representative and/or Consultant will determine neatness of the installation. Cables that have not been properly combed and dressed will have to be re-dressed at the Cabling Contractor's expense. The Cabling Contractor shall coordinate with the Communications Consultant prior to termination in any communications room.
 - .4 The maximum horizontal run length is not to exceed 90 meters (300 feet). If the 90 meters (300 feet) constraint cannot be met, the Cabling Contractor is to notify the Consultant of any cables that exceed 90 meters (300 feet), prior to their installation.
 - .5 Any deviation from the cable routing, outlet and equipment locations shown on drawings must be approved by the Owner/Consultant and documented on as-built drawings.
 - .6 Avoid scraping, denting, or otherwise damaging cables, before, during or after installation. The Cabling Contractor without any additional compensation shall replace damaged cables.

- .7 Ensure that all cable lengths are sufficient to allow for slack, vertical runs, wastage, connectorization and future moves.
- .8 Bush, ream, and remove any sharp projections on all conduits prior to installation of communications cables.
- .9 When terminating copper cables remove only enough cable jacket to perform termination, untwist pairs a maximum of 13 millimeters (1/2 inch) for Category 6, Enhanced Category 6 and proposed Category 6 cable.
- .8 Faceplates
 - .1 Jacks and/or connectors shall be terminated to the appropriate cable and inserted in the correct orientation into the faceplate prior to the mounting of the faceplate.
 - .2 Cable slack shall be stored behind the faceplate in such a way that allows the minimum bend radius of the cable to be maintained as per the following: Fibre Optic Cable, a minimum of 3 feet (1 meter) slack with a minimum bend radius of 1.18 inches (30 millimeters). U.T.P. cable, a minimum of 1 foot slack with a minimum bend radius of 4 times the cable diameter. Care shall be taken when mounting the faceplate to avoid crimping or kinking the cables.
 - .3 Faceplates shall be securely mounted to a surface mounted housing, a recessed box, or box eliminator bracket.
 - .4 Faceplates shall be labeled with the appropriate port designations as per the E.I.A./T.I.A. 606 standard.
- .9 Category 6 Jacks – U.T.P.
 - .1 Jacks shall be installed to provide minimal signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination. The amount of untwisting in a pair as a result of termination to the jack I.D.C. shall be no greater 0.5 inches (13 millimeters).
 - .2 Jacks shall be installed according to manufacturer's instructions and properly mounted in plates, frames, housings or other appropriate mounting device.
 - .3 Jacks shall be installed such that cables terminated to the jacks maintain minimum bend radius of at least 4 times the cable diameter into the I.D.C. contacts. Cables shall be terminated on jacks such that there is no tension on the conductors in the termination contacts.
- .10 Horizontal Cabling

- .1 Cable shall be installed to provide minimal signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination. The amount of untwisting in a pair as a result of termination shall be no greater than 0.5 inches (13 millimeters).
- .2 Shall be installed according to manufacturer's instructions.
- .3 Shall be installed such that cables can maintain minimum bend radius of at least 4 times the cable diameter. Cables shall be terminated in a way that there is no tension on the conductors in the termination contacts.
- .4 Shall be properly labeled on front and back with the cable number and port connections for each port.
- .5 Shall be installed in one continuous length unless specified in the contract document.
- .6 Adhere to T.I.A. standard requirements regarding pulling tension and allowable lubricants.
- .7 The Contractor shall assume the responsibility for any difficulties or damage to the cable during placement.
- .8 Contractor shall provide Owner with all installed cable measurements.
- .9 Firestop all openings where cable is installed through a fire barrier.
- .10 All cables shall have sufficient slack for retermination five times at both ends. Strain relief shall be provided sufficiently to secure cables to terminal panels. All cables are to be neatly tie-wrapped (plenum rated tie wraps) through wiring trays.
- .11 All data communication cables shall be separated from sources of electromagnetic radiation in accordance with T.I.A. Standard proposal SP-2072 and the following:
 - .1 If both data and small power cable (2 k.V.A. power circuits) are installed in grounded, ferrous metal conduit throughout the run, then no separation is required. (i.e. E.M.T. conduit).
 - .2 C.M.P. (FT-6) rated data cabling with no metallic raceway and power conductors (2 K.V.A. power circuits) in grounded raceway requires 5" (125 millimeters) clearance.
 - .3 For fluorescent luminaires the required clearance is 12 inches (300 meters).

- .4 Clearance increased up to 24 inches (600 millimeters) for power circuits over 5 K.V.A.
 - .5 For large motor, transformer, power panels, etcetera, the required clearance is 40 inches (1 meter).
 - .6 Cables must be routed to avoid direct contact with steam piping, hot water piping or other heat sources to avoid thermal degradation.
- .12 Testing
- .1 The communications Contractor shall perform a full Category 6e test for every data drop installed in order to verify for a 100/1000 megabits per second solution. Testers to be used shall be Microtest Omniscanner or Fluke D.S.P. 4000.
 - .2 Upon completion of the testing, the Consultant may ask the Contractor to perform random tests of up to 30% of the cables. A penalty of \$50.00 will be deducted from the contract amount for each cable that fails the test.
 - .3 All tests shall be in accordance with A.N.S.I./E.I.A./T.I.A. =568B.1, Section 11, Cabling Transmission Performance and Test Requirements.
 - .4 Category 6e field test parameters shall be:
 - .1 Wiremap
 - .2 Insertion loss
 - .3 Equal-level far end cross-talk (ELFEXT)
 - .4 Power sum Equal-level far end cross talk (PSELFEXT)
 - .5 Propagation Delay
 - .6 Length
 - .7 Near end cross talk (NEXT)
 - .8 Power sum near end cross talk (PSNEXT)
 - .9 Return loss
 - .10 Delay skew
 - .5 Voice cables shall also be tested for continuity, shorts, opens, grounds, correct polarity and length.

- .6 Jacks shall be tested as part of the installed horizontal cabling system.
- .7 Category 6e Jacks shall be tested as part of the channel for Length, DC continuity, NEXT, PSNEXT, Attenuation, Return Loss, ELFEXT, and PSELFEXT using a level IIe tester for Category 6e channel compliance.
- .8 Test patch cords to portable tester must be designed for testing by the manufacturer. Field assembled patch cords are not acceptable. Field testers must use the appropriate jack/tester adapter specified for use with the cabling jack(s) specified within this document.
- .9 The nominal velocity of propagation (N.V.P.) must be set specify to each cable manufacturer before testing. Portable tester to be calibrated on a minimum annual basis.
- .10 Testing of horizontal cables is to be completed in accordance with the following test criteria. The testing must be completed on the Channel Level. Testing is to be completed from both ends o f the installed cable. Testing of the cabling must confirm to the following Standards:
Category 6e: E.I.A./T.I.A. -568-A-5 'Transmission Performance Specifications for 4-Pair 100 Ohm Category 6 E.
- .11 Cabling Contractor to produce a test report based on the cable schedules. The report should indicate for each cable, when it was tested successfully and the signature of the technician that performed the test, location, cable type, cable number and tester make and model. A copy of the test report must be submitted to the Consultants for approval. The entire report must be signed by an authorized person for the Cabling Contractor at the end of the project.
- .12 Correct all cable faults. Splicing of any cables will not be permitted, for any reason, unless prior authorization is received in writing from the Consultant.
- .13 A "PASS" indication shall be obtained for all link or channel tests when tested using the appropriate level tester for the appropriate category.
- .14 Testers shall be correctly set to test the type and manufacturer of the horizontal cable used in the link or channel being tested, including the correct N.V.P.

- .15 Link attenuation shall be calculated as: *Link attenuation = cable attenuation + connector insertion loss + splice insertion loss.*
- .16 The Owner's Computer Services personnel will conduct a random audit of the newly installed wiring (time frame 9-days from completion) and if the failure rate is greater than 10%, the Contractor will assume the cost of hiring a third party to complete a full audit of all the new network drops.
- .13 Test Results
 - .1 Test results shall be submitted in hard and electronic format. Electronic reports shall be submitted on C.D. format in a Windows based database (Microsoft Excel is acceptable). All electronic reports must be accompanied by a certificate signed by an authorized representative of the company warranting the truth and accuracy of the electronic report. Hard copy of the report is to be submitted triplicate in three individual binders.
 - .2 The test result documentation shall be submitted to the Electrical Contractor no later than 10 working days following the completion of the installation.
- .14 As Built Drawings
 - .1 This Contractor shall maintain an updated copy of as-built drawings on site at all times.
 - .2 At the end of the project, the Contractor shall obtain AutoCAD files from the Consultant and update them with the work performed by the Contractor. This Contractor shall provide one (1) electronic copy of updated as-built drawings.
 - .3 As-built drawings shall be submitted to the Consultant no later than 10 working days following the completion of the installation.
- .15 Warranty
 - .1 The Contractor shall provide a system warranty covering the installed cabling system against defects in workmanship, components, and performance, and follow-up support after project completion for a period of one year.
 - .2 The Contractor shall warrant the cabling system against defects in workmanship for a period of one year from the date of system acceptance by the Board. The warranty shall

cover all labour and materials necessary to correct a failed portion of the system and to demonstrate performance within the original installation specifications after repairs are accomplished. This warranty shall be provided at no cost to the Owner.

- .3 The performance warranty shall warrant properly installed 100 M.H.Z. horizontal copper portion of the cabling system. Copper links shall be warranted against the link performance minimum expected results defined in the T.I.A./E.I.A. 568A, and TSB-67.
- .4 The Contractor shall provide a guaranteed twenty four (24) hour response time to any warranty claims.
- .5 The Communications Cabling Contractor will be required to provide a 25 year manufacturer's Extended Component Warranty and an Application Assurance Warranty for the entire communications cabling system. Warranty shall be in effect from the date of substantial completion as certified by the Architect.
- .6 The Communications Cabling Contractor shall provide certification number within two weeks of award of the project.
- .7 The Communications Cabling Contractor shall provide a letter of Certification within two weeks of substantial completion. This document will include the following:
 - .1 Verification of the performance of the installed system.
 - .2 Manufacturer's certification number.
 - .3 Identification of the installation by location and project number.
- .8 The system manufacturer shall provide in writing to the Owner that in the event of the demise or failure of the installing certified system installer, the manufacturer shall be responsible for providing another certified system installer/vendor to fulfill the remainder of the warranty conditions.
- .9 Contractors must ensure that the selected network cabling components manufacturer and the wiring manufacturer have contractual relationships to ensure that the system warranty is a true "end to end" structured cabling system warranty.

- .10 All costs for these warranties must be included in the tender amount.

End of Section

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide site grading.

1.3 REFERENCES

- .1 ASTM D698; Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft lbf/ft³ (600 KN-m/m³)).

1.4 DEFINITIONS

- .1 Native Topsoil: existing on-site material, capable of supporting good vegetative growth and suitable for use in finish grading for sodding or seeding.

1.5 SITE CONDITIONS

- .1 Underground and surface utility lines and buried objects affected by the Work, are indicated on the drawings.
- .2 Locate and confirm any and all on-site services prior to commencement of grading operations.

2 PRODUCTS

2.1 MATERIALS

- .1 Fill material: Types 2 and 3, in accordance with Section 31 23 00.

- .2 Excavated or graded material existing on site may be suitable to use as fill for grading work if approved by Consultant, subject to laboratory analysis.
- .3 Protect approved material from contamination.

3 EXECUTION

3.1 PROTECTION

- .1 Protect all existing fencing, trees, landscaping, natural features, bench marks, buildings, pavement, surface or underground utility lines which are to remain, as directed by Consultant. If damaged, restore to original condition unless directed otherwise.

3.2 GRADING

- .1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.
- .2 Rough grade, using imported Type 2 fill material (Granular B), to the following levels below finished grade elevations:
 - .1 270mm for HD asphalt paving (minimum 350mm Type 2 fill).
 - .2 220mm for LD asphalt paving (minimum 200mm Type 2 fill).
 - .3 300mm for concrete paving and walks.
 - .4 250mm for unit paving.
- .3 Rough grade, using Type 3 fill material as required, to the following levels below finished grades:
 - .1 150mm for grassed areas.
 - .2 600mm for planting beds.
 - .3 1000mm for trees.
- .4 Slope rough grade away from building 1:50 minimum.
- .5 Prior to placing fill over existing ground, scarify surface to depth of 150mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
- .6 Compact filled and disturbed areas to Standard Proctor Maximum Dry Density (SPMDD) in accordance with ASTM D698 as follows:
 - .1 98% under paved and walk areas, Type 2 fill.
 - .2 85% under landscaped areas, Type 3 fill.
- .7 Do not disturb soil within branch spread of trees or shrubs to remain.

3.3 INSPECTION & TESTING

- .1 An independent testing laboratory designated by the Owner will carry out inspection and testing of soil compaction. Refer to Section 01 40 00 for extent and frequency of testing.

3.4 SURPLUS MATERIAL

- .1 Remove surplus material and material unsuitable for fill, grading or landscaping from site.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide excavating, trenching, backfill and compaction.

1.3 REFERENCE STANDARDS

- .1 OPSS-1010; Material Specification for Aggregates – Granular A, B, M and Select Subgrade Material (Ontario Provincial Standard Specification).
- .2 ASTM D698; Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft. lbf/ft³ (600 kN m/m³)).
- .3 CSA-A23.1; Concrete Materials and Methods of Concrete Construction.
- .4 CSA-A23.2; Methods of Test for Concrete.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Stockpiling Of Material
 - .1 Stockpile fill materials in areas designated. Stockpile granular materials in manner to prevent segregation.
 - .2 Protect fill materials from contamination.

1.5 SITE CONDITIONS

- .1 Location Of Existing Buried Utilities
 - .1 Existing utilities and structures indicated on the drawings are schematic only. Actual size, depth, and location must be determined by site locates and test excavation.

- .2 Prior to commencing any excavation work, notify applicable authorities, and establish location and status of use of buried utilities and structures. Engage authorities having jurisdiction to clearly mark such locations to prevent disturbance during work.
- .3 Confirm locations of buried utilities by careful test excavations.
- .4 Conduct condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, pavement, survey bench marks and monuments which may be affected by work.

1.6 SOURCE QUALITY CONTROL

- .1 Inform Consultant at least 4 weeks prior to commencing work, of proposed source of fill materials and provide access for sampling.

2 PRODUCTS

2.1 FILL TYPES

- .1 Fill Types are designated herein as "Type 1" etc., for clarity. Designations **do not** coincide with Soil Types defined in Section 226 of the Occupational Health & Safety Act.
 - .1 **Fill Type 1:** Granular A, to OPSS 1010.
 - .2 **Fill Type 2:** Granular B, to OPSS 1010.
 - .3 **Fill Type 3:** selected native material from excavation, having moisture content within 3% of optimum value, approved by the Geotechnical Engineer for use intended, unfrozen, free from roots, rocks larger than 75mm cinders, ashes, sods, refuse, or other deleterious materials.
 - .4 **Fill Type 4:** clean, coarse concrete sand to CSA A23.1, free from clay, shale, and organic matter.
 - .5 **Fill Type 5:** 20mm, clear crushed Limestone, to CSA A23.1 (rounded aggregate will not be acceptable).
 - .6 **Fill Type 6:** Foamed glass granular fill from 100% recycled container glass; by Glavel Inc., Burlington VT, or Aero Aggregates North America, Eddystone PA.

3 EXECUTION

3.1 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.2 PROTECTION

- .1 Existing buried utilities and structures:
 - .1 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated.
 - .2 Where utility lines or structures exist in area of excavation, obtain direction of Consultant before removing or re-routing. Pay costs of such work.
 - .3 Record location of maintained, re-routed and abandoned underground lines.
- .2 Existing Buildings and Surface Features:
 - .1 Protect existing buildings and surface features which may be affected by work from damage while work is in progress. In event of damage, immediately make repair to approval of Consultant.
 - .2 Where excavation necessitates root or branch cutting, do so only as approved by Consultant.
- .3 Excavations
 - .1 Protect bottoms of excavations from softening or freezing.
 - .2 Construct banks in accordance with local bylaws.
 - .3 Provide adequate protection around bench markers, layout markers, survey markers, and geodetic monuments.
 - .4 Effect approved measures to minimize dust as result of this work.
 - .5 Do not stockpile excavated material to interfere with site operation or drainage.
- .4 Shoring, Bracing And Underpinning
 - .1 Protect existing features in compliance with Section 01 50 00 and applicable local regulations.
 - .2 Engage services of qualified Professional Engineer registered in the Province of Ontario to design and inspect shoring, bracing and underpinning required for work.
 - .3 Submit design and supporting data at least (2) weeks prior to commencing work.
 - .4 Design and supporting data submitted to bear the stamp and signature of qualified Professional Engineer registered in the Province of Ontario.

- .5 Engineer responsible for design of temporary structures to submit proof of insurance coverage for professional liability except where Engineer is employee of Contractor, in which case Contractor shall submit proof that work by Professional Engineer is included in Contractor's insurance coverage.

3.3 DE-WATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while work is in progress.
- .2 Submit, for Consultant's review, details of proposed dewatering or heave prevention methods, such as dikes, well points, and sheet pile cut-offs.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur. Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water in a manner not detrimental to public and private property, or any portion of work completed or under construction.
- .6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, water courses or drainage areas.

3.4 EXCAVATION

- .1 Excavate to lines, grades, elevations and dimensions indicated.
- .2 Remove paving, walks, demolished foundations and rubble, and other obstructions encountered during excavation.
- .3 Excavation must not interfere with normal 45 degree splay of bearing from bottom of any footing.
- .4 Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw. Seal cuts with approved tree wound dressing.
- .5 For trench excavation, unless otherwise authorized by Consultant in writing, do not excavate more than 30m of trench in advance of installation operations and do not leave open more than 15m at end of day's operation.
- .6 Dispose of surplus and unsuitable excavated material off site.
- .7 Do not obstruct flow of surface drainage or natural watercourses.
- .8 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

- .9 Notify Consultant when soil at bottom of excavation is reached.
- .10 Obtain Consultant's approval of completed excavation.
- .11 Remove unsuitable material from trench bottom to extent and depth directed by Consultant.
- .12 Where required due to unauthorized over-excavation, correct as follows:
 - .1 Fill under bearing surfaces and footings with concrete specified for footings.
 - .2 Fill under other areas with Type 2 fill, compacted to not less than 95% Standard Proctor Maximum Dry Density (SPMDD).
- .13 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil. Clean out rock seams and fill with concrete mortar or grout to approval of Consultant.
- .14 Excavation exceeding that indicated in contract documents, if authorized in writing by Consultant before extra excavation is performed, will be paid as extra to Contract price in accordance with General Conditions.

3.5 FILL TYPES AND COMPACTION

- .1 Exterior Side of Perimeter Foundation Walls: Type 2 fill to subgrade level. Compact to 98% SPMDD in accordance with ASTM D698. Use Type 3 fill where approved by Testing and Inspection Authority.
- .2 Engineered Fill for Foundations: Type 1 fill to underside of base courses. Compact to 100% SPMDD in accordance with ASTM D698. Refer to Structural Drawings for location and depth. Engineered fill under footing shall be minimum 300mm compacted depth.
- .3 Sub-Base Courses
 - .1 For Asphalt Paving: Type 2 fill to underside of base course. Refer to Section 32 12 16 for depths and compaction rates.
 - .2 For Concrete Slabs-On-Grade
 - .1 Exterior Concrete Slabs and Paving: Type 2 fill placed in 200-300mm lifts, to underside of base course. Compact to minimum 98% SPMDD in accordance with ASTM D698.
 - .2 Interior Floor Slabs: Type 2 fill, placed in 200-300mm lifts, to underside of base course. Compact to minimum 98% SPMDD in accordance with ASTM D698.
- .4 Base Courses
 - .1 For Asphalt Paving: Type 1 fill to underside of asphalt. Refer to Section 32 12 16 for depths and compaction rates.

- .2 Concrete Slabs-On-Grade
 - .1 Exterior Concrete Slabs and Paving: 150mm Type 1 fill Compact to minimum 98% SPMDD in accordance with ASTM D698.
 - .2 Interior Floor Slabs: 200mm Type 6 fill, well-compacted.
- .5 Retaining Walls: provide 150mm Type 1 fill below retaining wall, compact to 100% SPMDD. Provide Type 5 fill to subgrade level on high side for minimum 300mm from wall, well compacted. For remainder, use Type 3 fill compacted to 95% SPMDD.
- .6 Underground Services:
 - .1 Refer to Civil Engineering Drawings for excavating trenching and backfill of site services.

3.6 BACKFILL

- .1 Do not proceed with backfill operations until Consultant has inspected and approved installations.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Prior to placing fill under slabs on grade, compact existing subgrade to obtain same compaction as specified for fill. Remove "soft" material and fill with approved material.
- .5 Prior to installation of foundations, compact existing subgrade to obtain required bearing capacity. Remove "soft" material and fill footing concrete.
- .6 Place backfill material in uniform layers not exceeding 152mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .7 Provide insulation protection at foundation wall until wall assembly is complete. If access to the interior of the building is being gained by equipment and machinery, access points must be covered with a rigid material (plywood) and earth is built up around the opening sufficiently to create a ramp condition. No debris is to enter between the insulation and foundation wall, no gaps or breaks in insulation is acceptable. Any and all damage to foundation insulation over the course of the project is to be repaired to the Consultant's approval before enclosing the building.
- .8 Backfill around services:
 - .1 Refer to Civil Engineering Drawings for excavating trenching and backfill of site services.

3.7 INSPECTION AND TESTING

- .1 Testing of materials and compaction will be carried out by testing laboratory designated by the Owner. Refer to Section 01 40 00.
- .2 Frequency of Tests
 - .1 Excavated surfaces: when undisturbed excavated surface is being prepared, make a series of 3 tests of surface for each 500m² area.
 - .2 Fill under floor or other slabs on grade: make 3 tests for every 2 lifts of compacted fill for each 500m² area.
 - .3 Backfill structural walls: test each different material for approximately each 50m of wall being backfilled, at depth increments of 600mm.
 - .4 If, during progress of work, tests indicate fills do not meet specified requirements, remove defective fills, replace and retest at no extra cost.

3.8 RESTORATION

- .1 Upon completion of work, remove surplus materials and debris from site, trim slopes, and correct defects as directed by Consultant. Reinstate topsoil, pavement, sidewalks and lawns to elevation which existed before excavation.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide the asphalt concrete pavement structure, including:
 - .1 Proof rolling of sub-base for compaction required,
 - .2 Placement, fine grading and final compaction of granular base material,
 - .3 Placement, compaction, and finishing of asphaltic concrete.

1.3 REFERENCE STANDARDS

- .1 OPSS-1010; Material Specification for Aggregates – Granular A, B, M and Select Subgrade Material (Ontario Provincial Standard Specification).
- .2 OPSS-1150; Material Specification for Hot Mix, Hot Laid Asphaltic Concrete (Ontario Provincial Standard Specification).
- .3 ASTM D698; Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft. lbf/ft³ (600 kN m/m³)).
- .4 ASTM D979; Practice for Sampling Bituminous Paving Mixtures.
- .5 ASTM D995; Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

1.4 PAVEMENT DESIGN

- .1 Refer to Geotechnical Report. The following pavement designs are required. Thicknesses referenced are "after compaction". Refer to drawings for location and extent of paving types:

- .1 Heavy Duty Asphalt
 - .1 SuBase Course: 350mm Granular B fill.
 - .2 Base Course: 150mm, Granular A fill.
 - .3 Binder Course: 80mm HL-8,
 - .4 Surface Course: 40mm HL-3.
- .2 Light Duty Asphalt
 - .1 SuBase Course: 200mm Granular B fill.
 - .2 Base Course: 150mm, Granular A fill.
 - .3 Binder Course: 40mm HL-8,
 - .4 Surface Course: 30mm HL-3.

1.5 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
- .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

2 PRODUCTS

2.1 MATERIALS

- .1 Base Materials
 - .1 Type 1 fill: imported, OPSS 1010 Granular "A".

- .2 Type 2 fill: imported, OPSS 1010 Granular "B".
 - .2 Asphalt Prime: MTO Primer, or SS-1 to OPSS 1103.
 - .3 Sand Blotter: clean concrete sand, passing 4.75mm sieve and free from organic matter or other deleterious materials.
 - .4 Asphaltic Concrete: hot mix, hot laid asphaltic concrete, to OPSS 1150.
 - .1 Binder Course: HL-8.
 - .2 Surface Course: HL-3.
 - .5 Traffic Painting: to Section 32 17 23.
- 2.2 PLANT AND MIXING REQUIREMENTS
- .1 To ASTM D995, and OPSS 1150.
- 2.3 EQUIPMENT
- .1 Pavers: mechanical grade controlled self powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.
 - .2 Rollers: sufficient number of rollers of type and weight to obtain specified density of compacted mix.
 - .3 Vibratory Rollers
 - .1 Minimum drum diameter: 750mm.
 - .2 Maximum amplitude of vibration machine setting: 0.5mm for lifts less than 40mm thick.
 - .4 Haul trucks
 - .1 Adequate size, speed and condition to ensure orderly and continuous operation, and as follows:
 - .1 Boxes with tight metal bottoms.
 - .2 Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.
 - .3 In cool weather or for long hauls, insulate entire contact area of truck.
 - .5 Suitable hand tools.
- 2.4 SOURCE QUALITY CONTROL
- .1 Submit mix designs from asphalt supplier for review by Consultant prior to mobilization for asphalt pavement work.

3 EXECUTION

3.1 PREPARATION

- .1 Verify grades of subgrade drains, maintenance holes, catch basins, and other items set in paving area for conformity with elevations and sections before placing granular base materials.
- .2 Where placement of granular base does not immediately follow sub-base, or where sub-base has suffered severe weather conditions, proof roll sub-base by numerous passes of compaction equipment to ensure that a uniform 98% Standard Proctor Maximum Dry Density (SPMDD) is achieved.
- .3 Obtain approval of sub-base by Consultant before placing granular base.
- .4 Place granular base material on clean unfrozen surface, properly shaped and compacted and free from snow and ice.
- .5 Sub-excavate any loose or softened areas to competent material and backfill with compacted granular fill.

3.2 BASE & SUB-BASE COURSES

- .1 SubBase Courses
 - .1 Heavy Duty Pavement: 350mm compacted thickness of Granular B fill.
 - .2 Light Duty Pavement: 200mm compacted thickness of Granular B fill.
- .2 Base Courses
 - .1 Heavy Duty Pavement: 150mm compacted thickness of Granular A fill.
 - .2 Light Duty Pavement: 150mm compacted thickness of Granular A fill.
- .3 Grade to uniform levels or slopes between given elevations or between given elevations and existing surfaces, allowing for depth of asphalt surfacing.
- .4 Place subbase and base course in lifts not exceeding 150mm compacted thickness. Compact to 100% SPMDD in accordance with ASTM D698.

3.3 ASPHALT PRIME

- .1 Do not apply prime when air temperature is less than 5°C or when rain is forecast within 2 hours.

- .2 If asphalt prime fails to set within 24 hours, spread sand blotter material in amounts required to absorb excess material. Sweep and remove excess blotter material.

3.4 ASPHALT CONCRETE PAVING

- .1 Pavement Thickness
 - .1 Heavy Duty Paving
 - .1 Binder Course: 80mm HL-8, after compaction.
 - .2 Surface Course: 40mm HL-3, after compaction
 - .2 Light Duty Paving
 - .1 Binder Course: 40mm HL-8, after compaction.
 - .2 Surface Course: 30mm HL-3, after compaction.
- .2 Obtain approval of base and primer from Consultant before placing asphalt mix.
- .3 Place asphalt mix only when base or previous course is dry and air temperature is above 5°C.
- .4 Paint contact edges of catch basins, and maintenance holes with hot asphalt prime before the mixture is placed against them.
- .5 Apply hot asphalt prime to existing asphalt when repaving, or over binder course applied more than 7 days before surface course application. Power wash surface prior to applying prime, to remove any and all dirt, or other surface contamination. Allow to dry sufficiently.
- .6 Binder courses applied less than 7 days prior to surface course application shall be power-washed to remove any and all dirt, or other surface contamination, and allowed to dry sufficiently. Power washing may be done in lieu of applying prime, to the approval of the Consultant.
- .7 Place asphalt concrete in compacted layers not exceeding 50mm.
- .8 Minimum 135°C mix temperature required when spreading.
- .9 Maximum 160°C mix temperature permitted at any time.
- .10 Compact each course with roller as soon as it can support roller weight without undue cracking or displacement.
- .11 Compact asphalt concrete to density not less than 95% of density obtained with Marshall specimens prepared in accordance with ASTM D1559 from samples of mix being used.

- .12 Roll until roller marks are eliminated. Keep roller speed slow enough to avoid mix displacement and do not stop roller on fresh pavement.
- .13 Moisten roller wheels with water to prevent mix adhesion.
- .14 Compact mix with hot tampers, or other equipment approved by Consultant, in areas inaccessible to roller.
- .15 Finish surface smooth, of uniform density and texture, true to grade to within 10mm and with no irregularities greater than 10mm in 4.5m.
- .16 Repair areas showing checking, rippling or segregation as directed by Consultant.

3.5 JOINTS

- .1 Remove surplus material from surface of previously laid strip. Do not deposit on surface of freshly laid strip.
- .2 Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material prior to placing adjacent pavement.
- .3 For cold joints, cut back to full depth vertical face and tack face with hot asphalt.
- .4 For longitudinal joints, overlap previously laid strip with spreader by 25 to 50mm.

3.6 PROTECTION

- .1 Keep vehicular traffic off newly paved areas until paving surface temperature has cooled below 38°C. Do not permit stationary loads on pavement until 72 hours after placement.
- .2 Provide access to buildings as required. Arrange paving schedule so as not to interfere with normal use of premises.

3.7 FIELD QUALITY CONTROL

- .1 The work of this section is subject to inspection and testing as specified in Section 01 40 00. Costs for inspection and testing will be paid from a cash allowance, as allocated in Section 01 21 00.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide exterior concrete paving, curbs, walks, and gutters to configurations indicated.

1.3 REFERENCE STANDARDS

- .1 ASTM D698; Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft. lbf/ft³ (600 kN m/m³)).
- .2 ASTM D1751; Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- .3 CSA-A23.1; Concrete Materials and Methods of Concrete Construction.
- .4 CSA-A23.2; Methods of Test for Concrete.
- .5 CSA-A5; Portland Cement.
- .6 CSA-G30.5; Welded Steel Wire Fabric for Concrete Reinforcement.
- .7 CAN/CSA-G30.18; Billet-Steel Bars for Concrete Reinforcement.

1.4 QUALITY ASSURANCE

- .1 Prior to starting concrete work, submit quality control procedures for Consultant's approval for following items:
 - .1 Hot weather concrete,
 - .2 Cold weather concrete,
 - .3 Curing,
 - .4 Finishes,
 - .5 Formwork removal.

- .2 Certification: Provide certification from the Ready-Mixed Concrete Association of Ontario (RMCAO) of the following:
 - .1 Certification of concrete production facilities,
 - .2 Mix proportions selected will produce concrete of specified quality and yield,
 - .3 Mix design is adjusted to prevent alkali aggregate reactivity, and
 - .4 Strength will comply with CSA-A23.1.
 - .3 Pre-construction Meeting
 - .1 Convene a pre-construction meeting for the work specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Installation Subcontractor (Site Foreman & Project Manager)
 - .2 Related Subcontractors (ie. Landscape)
 - .3 Consultant.
- 1.5 ENVIRONMENTAL CONDITIONS
- .1 Do not pour concrete during, or for 24 hours after, rain/snow fall.
 - .2 Examine subgrade and ensure soil material is not frozen or saturated with water. Do not use frozen base materials. Do not install base on frozen subgrade.
- 2 PRODUCTS**
- 2.1 MATERIALS
- .1 Portland Cement: to CSA-A5.
 - .2 Water: to CSA-A23.1.
 - .3 Aggregates: to CSA-A23.1.
 - .4 Reinforcing Steel: Canadian manufactured deformed steel to CSA G30 Series.
 - .5 Welded steel wire fabric: to CSA G30.5. Provide in flat sheets only.
 - .6 Air Entraining Admixture: to CSA-A23.1.
 - .7 Joint Filler: asphalt impregnated fiberboard, to ASTM D1751.
 - .8 Curing Compound: to CSA-A23.1.
 - .9 Granular Base: Granular A to OPSS 1010.
 - .10 Granular SubBase: Granular B to OPSS 1010.
- 2.2 CONCRETE MIX

- .1 Proportion normal density, sulfate resistant concrete in accordance with CSA-A23.1, and as follows:
 - .1 Cement: Type 10, grey Portland Cement.
 - .2 Minimum compressive strength at 28 days: 32MPa.
 - .3 Exposure Classification: C-2.
 - .4 Coarse Aggregate Size: 20mm, crushed (smooth aggregate not acceptable).
 - .5 Slump at time and point of discharge: 65 to 100mm.
 - .6 Air Content: 5 to 8%.

3 EXECUTION

3.1 PREPARATION

- .1 Perform subgrade preparation work in accordance with Section 31 22 13.

3.2 GRANULAR BASE & SUB-BASE

- .1 Obtain Consultant's approval of subgrade before placing granular material.
- .2 Place granular material in maximum lifts of 150mm.
- .3 SubBase: Minimum 150mm Granular B fill; compact to 98% of Standard Proctor Maximum Dry Density (SPMDD) to ASTM D698.
- .4 Base: Minimum 150mm Granular A fill; compact to 98% of Standard Proctor Maximum Dry Density (SPMDD) to ASTM D698.

3.3 PLACEMENT OF CONCRETE

- .1 Place reinforcing steel and welded wire fabric in accordance with details and reviewed shop drawings.
- .2 Obtain Geotechnical Engineer's approval of granular base prior to placing concrete. Obtain Consultant's approval of placement of reinforcing steel prior to placing concrete
- .3 Perform concrete work in accordance with CSA-A23.1.

3.4 EXPANSION, CONTROL AND ISOLATION JOINTS

- .1 Install expansion joints at maximum intervals of 6m, or as indicated on the drawings.
- .2 Install expansion/isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings or other permanent structure.
- .3 Install 13mm thick joint filler of maximum practical length in expansion and isolation joints, from bottom of pour to within 6mm of finished surface.
- .4 Control Joints: install transverse control joints at intervals of 1.5m, or as indicated on the drawings. **TOOL JOINTS PRIOR TO PERFORMING FLOAT OR BROOMED FINISH.**

- .5 When sidewalk is adjacent to curb, align joints of curb, gutters and sidewalks.

3.5 CURBS

.1 Slipform/Extrusion Method

- .1 The slipform/extrusion machine approved shall be so designed as to place, spread, consolidate, screen and finish the concrete in one complete pass in such a manner that the minimum of hand finishing will be necessary to provide a dense and homogeneous concrete section.
- .2 The machine will shape, vibrate and/or extrude the concrete for the full width and depth of the concrete section being placed.
- .3 The operation of the machine shall be continuous until a section or scheduled pour is completed. The interval between successive loading of the concrete hopper shall not exceed 30 minutes.
- .4 If the operations are delayed, or if the section is to be continued later, the machine shall be emptied and a standard construction joint shall be formed. A similar joint shall be constructed at the beginning of the extruded section. Excess concrete which has passed through the machine shall not be re-used.

.2 Formed Method

- .1 The forms shall be of wood, metal or other suitable material that is straight and free from warp, having sufficient strength to resist the pressure of the concrete without displacement and sufficient tightness to prevent leakage.
- .2 Flexible or rigid forms of proper curvature are to be used for curves having a radius of 40m (130 ft.) or less. Division plates shall be metal.
- .3 The front and back forms shall extend for the full depth of the concrete. All of the forms shall be braced and staked so that they remain in horizontal and vertical alignment until their removal. They shall be cleaned and coated with an approved form release agent before concrete is placed against them.
- .4 The concrete shall be deposited into the forms without separation and then it shall be tamped, spaded or mechanically vibrated for thorough consolidation.
- .5 Rolled curbs may be formed without the use of a face form by using a straight edge and template to form the curb face. When used, face forms shall be removed as soon as possible to permit finishing. Other forms shall be removed after concrete has set.

3.6 FINISHING

- .1 Finish concrete in accordance with CSA-A23.1 and Section 03 35 00. Use referenced procedures for removal of excess bleed water. Ensure surface is not damaged.
- .2 Float surface of concrete to CSA-A23.1, with wood float, and bring surface to true elevation.
- .3 Non-Slip Surfaces: provide uniform broom finish to concrete paving on sloped grades exceeding 3%, and to all sidewalks, by drawing broom across surface of concrete perpendicular to direction of travel. Provide finish to edges of concrete with no smooth tooled edge borders.

3.7 CURING & PROTECTION

- .1 Protect surface from rapid moisture evaporation to avoid plastic shrinkage cracking, when severe drying conditions (sun, wind, humidity) are anticipated, in accordance with CSA A23.1.
- .2 Cure concrete in accordance with Section 21 of CSA A23.1.
- .3 Add curing compound evenly over entire surface of concrete in continuous film.
- .4 Allow concrete to cure minimum 7 days prior to backfilling or installing adjacent landscaping.

3.8 TOLERANCES

- .1 Surface tolerances to CSA-A23.1, Table 19, Class A.

3.9 FIELD QUALITY CONTROL

- .1 Inspection and testing of concrete will be carried out by an Inspection and Testing Laboratory, in accordance with Section 01 40 00, and CAN/CSA-A23.2.
- .2 The cost of inspection and testing will be paid from a Cash Allowance as allocated in Section 01 21 00.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide pavement markings including:
 - .1 Line painting
 - .2 Zone marking
 - .3 Traffic symbols
 - .4 Barrier-free parking symbols

1.3 REFERENCE STANDARDS

- .1 CAN/CGSB 1-GP-74M; Alkyd Traffic Paint.

1.4 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
- .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/

shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.

- .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.
- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

2 PRODUCTS

2.1 MATERIALS

- .1 Traffic Paint: to CAN/CGSB 1-GP-74M, fast-dry alkyd traffic paint;
 - .1 Colours: white, yellow, blue.

2.2 EQUIPMENT

- .1 Spray Equipment: walk-behind airless spray equipment, specific to pavement line painting operations.
- .2 Brushes: for commercial grade painting.
- .3 Templates: plywood symbol templates.

3 EXECUTION

3.1 PREPARATION

- .1 Clean pavement surfaces to be painted, of all dirt, oil, grease, or other foreign contaminants that will impair the adhesion of the paint.

3.2 PAINTED LINES & SYMBOLS

- .1 Apply paint by brush or spray, in accordance with manufacturer's written instructions. Do not apply at temperatures below (50°F) 10°C.
- .2 When spraying symbols, use approved plywood templates.

3.3 SCHEDULE

- .1 Refer to Site Plan drawings for locations and extent of line painting.
 - .1 Parking Lines: (4") 100mm wide solid yellow lines.
 - .2 Barrier Free Symbols: standard yellow barrier free symbol, at each B.F. parking stall.
 - .3 Traffic Arrows: standard white arrows; straight, left-turn, right turn.
 - .4 Stop Lines: (12") 305mm wide solid white line, from centre of road or drive to edge of pavement, at all stop signs.
 - .5 Centre Lines: (4") 100mm wide solid yellow line, (20'-0") 6m long from Stop Line, at centre of road or drive, at all stop signs.
 - .6 Safety Zones: (12") 305mm wide diagonal yellow lines and borders.

- 3.4 PROTECTION
 - .1 Keep vehicular traffic off newly painted areas until paint has sufficiently dried.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.
- .2 The Contractor shall, together with any and all Subcontractors involved in the work of this section, examine all surfaces or conditions relating to the Work, in order to determine the acceptability of such surfaces or conditions for the work of this section to commence.
- .3 Subcontractors shall report in writing, any observed defects or deficiencies in any surfaces or conditions that would adversely affect the work of this section, to the Contractor for correction prior to commencing the work of this section.
- .4 Commencement of the work of this section shall imply acceptance of all surfaces and conditions.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide tactile warning surfacing items, including all associated hardware, fasteners, accessory materials and installation.

1.3 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator
 - .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.
 - .2 Installation/Application
 - .1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/application shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.
 - .3 Documentation
 - .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.

- .4 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

1.4 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 30 00.
 - .2 Indicate dimensions, tolerances, and adjacent construction. Also indicate profiles of components, elevations, anchorage details, required reinforcing, location of isolation coating, description of related components, finishes and fasteners.
- .2 Samples
 - .1 Submit samples of all items specified herein, in accordance with Section 01 30 00.

2 PRODUCTS

2.1 EXTERIOR TACTILE WALKING SURFACE INDICATORS

- .1 Tactile Walking Surface Indicators shall be made of cast-iron plate, meeting CSA B651-2012 and Ontario Regulation 191/11, and meet the following requirements:

<u>Standard</u>	<u>Property</u>	<u>Minimum Result</u>
ASTM C1028	slip resistance	dry 0.8 min, wet 0.80 min
ASTM C501	wear resistance	wear index: > 500
ASTM D695	compressive strength	> 172MPa
ASTM D543	chemical resistance	no effect
ASTM B117	salt spray (300 hrs)	no effect

- .1 Tile Size: (24"x24") 600mm x 600mm.
- .2 Surface Pattern: truncated domes.
- .3 Colour: Black.
- .4 Accessories: provide anchors and expansion shields.
- .5 Acceptable Products:
 - .1 ADV-CI-2424 Cast Iron Tactile Walking Plates, by Kinesik.
 - .2 Cast Iron Tactile Walking Plates by Neenah Enterprises Inc.
 - .3 An approved equivalent.

3 EXECUTION

3.1 INSTALLATION

- .1 Locate and install tactile walking surface indicators as indicated on the drawings.
- .2 Locate units in proper alignment with adjacent work.
- .3 Install tactile walking surface indicators using provided anchors and expansion shields, according to manufacturer's specifications and instructions.

3.2 CLEANING

- .1 During installation, remove all corrosive or foreign materials or droppings resulting from work of this trade.

END OF SECTION



Geotechnical Investigation Report Fire Station #2 - 100 Marina Blvd, Peterborough

November 5, 2021

Prepared for:
The City of Peterborough

Cambium Reference: 13544-003

CAMBIUM INC.

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- Appendix B Rock Core Photographs
- Appendix C Physical Laboratory Testing Results
- Appendix D Corrosivity Analysis Results
- Appendix E 2015 National Building Code Seismic Hazard Values



1.0 Introduction

Cambium Inc. (Cambium) was retained by The City of Peterborough (Client) to complete a geotechnical investigation to assist in the design and construction of the proposed Fire Station #2 and associated parking and access, located at the current site of the Northcrest Arena, 100 Marina Blvd, Peterborough, Ontario (Site).

It is understood that the structure is to be 1,003 m² and 1-2 storeys with high volume apparatus bays and support spaces including offices and accommodations. The structure is not to have a basement and is to be slab-on-grade construction.

The geotechnical investigation was required to confirm the existing subsurface and groundwater conditions present at the Site, and prepare design and construction recommendations for the proposed structure and associated parking. A Site Plan, including borehole locations and monitoring well location, is included as Figure 1 of this report.

This report presents the methodology and findings of the geotechnical investigation at the Site and addresses requirements and constraints for the design and construction of the building and pavement structure.



2.0 Methodology

2.1 Borehole Investigation

A borehole investigation was conducted on October 4th, 5th and 8th, 2021, to assess subsurface conditions at the Site. Ten (10) boreholes, designated as BH101-21 through BH110-21, including two (2) hand SPT holes BH106-21 and BH110-21, were advanced at the Site. Five (5) of the boreholes, BH101-21 through BH105-21, were advanced within or near the proposed building footprint. All boreholes, except BH106-21, encountered auger refusal on presumed bedrock at depths less than 1 m below existing grade (mbeg) to 2.5 mbeg. Boreholes BH101-21 and BH102-21 were extended approximately 3 m into bedrock and bedrock cores obtained. Boreholes MW104-21 and MW107-21 were equipped as monitoring wells. .

The location of the boreholes was measured in the field and the UTM coordinates of each borehole were obtained using an RTK unit outdoors and a total station inside the arena. The elevation of the boreholes was surveyed relative client provided geodetic benchmark. The borehole locations are shown on Figure 1.

Drilling and sampling was completed using a truck-mounted drill rig, under the supervision of a Cambium technician. The boreholes were advanced to the pre-determined depths by means of continuous flight solid stem augers with 50 mm O.D. split spoon samplers. Standard Penetration Test (SPT) N values were recorded for the sampled intervals as the number of blows required to drive a split spoon (SS) sampler 305 mm into the soil using a 63.5 kg drop hammer falling 750 mm, as per ASTM D1586 procedures. The SPT N values are used in this report to assess consistency of cohesive soils and relative density of non-cohesive materials. Soil samples were collected at 0.75 m intervals from 0 mbeg to 3 mbeg and 1.5 m intervals at depths greater than 3.0 mbeg. The encountered soil units were logged in the field using visual and tactile methods, and samples were placed in labelled plastic bags for transport, future reference, possible laboratory testing, and storage. Open boreholes were checked for groundwater and general stability prior to backfilling. All boreholes were backfilled and sealed in accordance with Ontario Regulation (O.Reg.) 903.



Borehole logs are provided in Appendix A and photographs of the rock cores are provided in Appendix B. Site soil and groundwater conditions are described, and geotechnical recommendations are discussed in the following sections of this report.

2.2 Physical Laboratory Testing

Physical laboratory testing, including five (5) particle size distribution analyses (LS-702,705), was completed on selected soil samples to confirm textural classification, assess geotechnical parameters, and in some cases estimate soil percolation rates. Moisture content testing was completed on all soil samples. Results are presented in Appendix C and are discussed in subsequent sections of this report.

2.3 Corrosivity Analysis

Two (1) soil samples were submitted to Caduceon Laboratories for analysis of corrosivity testing to determine the corrosion potential of the soil and the potential for sulphate attack on concrete. Results are presented in Appendix D and are discussed Section 4.11.



3.0 Subsurface Conditions

Subsurface conditions at the Site are variable. Topsoil was encountered at surface in boreholes MW107-21 and MW108-21. Asphalt was encountered at surface in boreholes BH101-21, BH102-21, BH105-21, and BH109-21. The site consisted of a mix of soils from sand and gravel to silt and sand. Soils were generally moist to wet at the time of investigation and found to have a compact relative density, except in boreholes BH102-21 through MW104-21 where loose soils were encountered. Bedrock was encountered in all boreholes, except BH106-21, and ranged in depth from 0.76 mbeq to 2.74 mbeq. Groundwater appears to be at depths greater than 1.5 mbeq throughout the site, although some immediately above the bedrock were found to be wet at shallower depths.

The individual soil units are described in detail below and shown on the borehole logs provided in Appendix A.

3.1 Topsoil

Boreholes MW107-21 and MW108-21 were the only boreholes to encounter topsoil. The topsoil was found to be 300 mm and 200 mm thick in each borehole, respectively. The topsoil was a dark brown silt with some sand and trace organics and was found to be moist and loose at the time of the investigation.

3.2 Asphalt

A 50mm thick lift of asphalt was encountered in boreholes BH101-21, BH102-21, and BH105-21. A 25 mm thick lift of asphalt was encountered in borehole BH109-21. These were the only boreholes that encountered asphalt.

3.3 Sand and Gravel

Brown to brown-grey 'sand and gravel' and sandy gravel were encountered near surface and at depth in several boreholes. Sand and gravel, with trace to some silt, was encountered immediately below the topsoil and asphalt in boreholes BH102-21, MW108-21, and BH109-21, and at surface in MW104-21. The sand and gravel extends to a depth of 0.75 mbeq in



boreholes MW108-21 and BH109-21, and to depths of 0.35 mbeg and 0.1 mbeg, in boreholes BH102-21 and MW104-21 respectively. The sand was found to be moist at the time of investigation. SPT N values ranging from 13 to 19 provide evidence of a compact relative density.

A lower horizon of sandy gravel to gravelly sand, with trace to some silt, was encountered in boreholes BH101-21, MW104-21, BH106-21, and MW107-21, at depths of 0.75 mbeg to 0.9 mbeg, 1.65 mbeg to 2.74 mbeg, 1.2 mbeg to 1.83 mbeg, and 1.5 mbeg to 2.59 mbeg, respectively. This sand and gravel was found to be moist to wet at the time of investigation and SPT N values ranging from 16 to greater than 50 provide evidence of a compact to dense relative density.

Laboratory particle size distribution analyses were completed for two (2) sample of the sand and gravel material. The analysis results, based on the Unified Soil Classification System (USCS) scale, are summarized in Table 1, with full results provided in *Appendix C*.

Table 1 Particle Size Distribution Analysis

Borehole	Depth (mbeg)	Soil	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	(%) Moisture Content
BH102-21 SS3B	1.6 – 1.7	Silt and Sand	9	38	53		26.6
BH106-21 SS3	1.2 – 1.8	Sand and Gravel	43	47	10		6.0
MW107-21 SS3	1.5 – 2.0	Sandy Gravel	63	25	12		3.2
BH109-21 SS2	0.8 – 1.2	Silt and Sand	1	40	59		20.6
BH110-21 SS2B	0.8 -1.0	Silt and Sand	3	40	57		20.4

3.4 Silt and Sand

The bulk of the soil encountered on site was found to be a mix of light brown sand and silt, ranging from sandy silt to silt and sand, with trace gravel and clay. The silt and sand was present in every borehole, except borehole BH106-21, extending to depth of termination in boreholes BH102-21, BH103-21, and MW108-21 through BH110-21. A relatively thin horizon of sand was found to split the silt and sand in boreholes BH102-21 and MW108-21. The silt



and sand was found to be moist to wet at the time of investigation and SPT N values ranging from 3 to 20 provide evidence of soils with very loose to compact relative density.

Laboratory particle size distribution analyses were completed for three (3) samples of the silt and sand material. The analysis results, based on the Unified Soil Classification System (USCS) scale, are summarized in Table 1, with full results provided in *Appendix C*.

3.5 Sand

Brown sand with varying amounts of silt and gravel was encountered in boreholes BH102-21, MW104-21 through BH106-21, MW108-21, and BH110-21. The sand was encountered at depths of 0.96 mbeg to 1.5 mbeg, 1.6 mbeg to 2.1 mbeg, 0.75 mbeg to 1.83mbeg, surface to 1.2 mbeg, 0.75 mbeg to 1.35mbeg, and surface to 0.8 mbeg, respectively. The sand was found to be moist at the time of investigation, except in borehole MW104-21, where it was found to be moist to wet. SPT N values ranged from 4 to 37, providing evidence of compact soils in most instances, but loose relative densities in boreholes BH102-21 and MW104-21.

3.6 Bedrock

Bedrock was encountered in all boreholes except BH106-21, which was terminated in compact to dense soil. It is assumed that bedrock was encountered in each of these boreholes based on auger and split spoon refusal, as well as confirmation of bedrock in boreholes BH101-21 and BH102-21. A summary of bedrock depths is outlined in Table 2 below.

Table 2 Depth to Bedrock

Borehole	Surface Elevation (masl)	Depth of Presumed Bedrock (mbeg)	Elevation of Presumed Bedrock (masl)
BH101-21	210.96	0.86	210.10
BH102-21	211.11	2.49	208.62
BH103-21	210.91	0.76	210.15
MW104-21	210.73	2.74	207.99
BH105-21	210.98	1.83	209.15
BH107-21	211.44	2.59	208.85



BH108-21	211.19	1.83	209.36
BH109-21	211.16	1.68	209.48
BH110-21	210.19	1.22	208.97

Bedrock cores obtained from boreholes BH101-21 and BH102-21 provide evidence that the bedrock is weathered at the bedrock/soil interface, otherwise is thinly bedded, grey, streaked dark grey limestone of the Verulam Formation, with frequent shale partings. The bedrock was found to have a Rock Quality Designation (RQD) of 40 to 53, which reflects a poor to fair quality rock.

Bedrock was encountered at depth of 0.86 mbeg (211.5 masl) and 2.49 mbeg (210.00 masl) in boreholes BH101-21 and BH102-21 respectively. The drill rig was able to auger through soft weathered bedrock to depths of 1.5 mbeg (210.86 masl) and 2.7 mbeg (209.79 masl), resulting in an apparent 0.64 m and 0.2 m thickness of weathered bedrock in borehole BH101-21 and BH102-21 respectively.

Based on the cored boreholes, an anticipated 0.2 m to 0.65 m of weathered bedrock should be expected at the bedrock/soil interface and appears to be thicker at shallower depths. Upon exposure during excavations, the bedrock should be inspected and any loose/weathered bedrock removed from the surface.

Photographs of the rock cores are presented in Appendix B.

3.7 Groundwater

Only boreholes MW104-21 and MW108-21 were found to have some groundwater seepage upon completion. The depth of first encounter refers the depth at which wet to saturated soils were first identified in the on-site soil investigation. It was evident that soils were found to be wet at depths as shallow as 0.75 mbeg in boreholes BH109-21 and BH110-21, 1.5 mbeg in boreholes MW104-21 and MW108-21, and near surface in borehole BH103.21. Saturated soils were not encountered within the limits of the investigation. The water elevations in all boreholes were measured on completion of drilling and prior to backfilling on October 4th and



5th, 2021. Water elevations within the monitoring wells were recorded on October 8, 2021. The results are summarized in Table 3.

Table 3 Groundwater Levels in Boreholes

Borehole	Surface Elevation (masl)	Termination Depth (mbeg)	Termination Elevation (masl)	Elevation of First GW Encounter (masl)	Water Elevation on Completion (masl)	Water Depth Oct. 8, 2021 (mbeg)	Water Elevation Oct. 8, 2021 (masl)
BH101-21	212.36	4.11	208.25	-	-	-	-
BH102-21	212.49	5.69	206.80	-	-	-	-
BH103-21	212.28	0.76	211.52	212.18	212.18	-	-
MW104-21	212.11	2.74	209.37	210.61	210.61	2.58	209.53
BH105-21	212.36	1.83	210.53	-	-	-	-
BH106-21	211.62	1.83	209.79	-	-	-	-
MW107-21	212.81	2.59	210.22	-	-	No Water	No Water
MW108-21	212.56	1.83	210.73	211.06	211.06	1.60	210.96
BH109-21	212.53	1.68	210.85	211.78	211.78	-	-
BH110-21	211.51	1.22	210.29	210.76	210.76	-	-

Water levels appear to be below 1.6 mbeg (210.9 masl) over the site. Upon completion and prior to backfilling, boreholes MW104-20 and MW107-20 through MW108-20 were equipped as monitoring wells. Water level measurements, ranging from 1.6 mbeg to 2.6 mbeg were observed in the monitoring wells on October 8, 2021.

At the time of investigation some soils encountered below the water levels in the monitoring wells were brown in colour, indicating that those soils are generally located above the groundwater table throughout much of the year. Soils below the groundwater table are generally grey in colour. The grey colour of the soil indicates prolonged exposure to groundwater, providing reducing, anoxic conditions. The elevated water level, into elevations of brown soil, are likely due to seasonally high water levels or water perched on top of the bedrock.

It should be noted that groundwater levels at the site may fluctuate seasonally and in response to climatic events and that Peterborough experienced significantly more than average rainfall in late September and early October 2021.



4.0 Geotechnical Considerations

The following recommendations are based on the borehole information and are intended to assist designers. Recommendations should not be construed as providing instructions to contractors, who should form their own opinions about site conditions. It is possible that subsurface conditions beyond the borehole locations may vary from those observed. If significant variations are found before or during construction, Cambium should be contacted so that we can reassess our findings, if necessary.

4.1 Site Preparation

Existing areas where organic material has been identified should be excavated and removed from beneath the proposed building and parking lot areas. Additionally, this material should be excavated and removed to a minimum distance of 3 m around the building footprint. This material includes but is not limited to the topsoil and any material that contains organics or debris, as identified in this report and is not appropriate for use as fill below grading and parking areas. All soil should be removed from above the bedrock in the areas of proposed footings. The bedrock should be scraped free of any loose, weathered material and inspected by a qualified person prior to placing footings or engineered fill. Cambium understands that the subject structure is to be slab-on-grade, and that external parking associated with the project will be surficial parking only.

Based on the recommended excavation depths for the building, the subgrade material is expected to consist of poor to fair limestone bedrock with frequent shale partings. The recommended excavation depth for the parking area is expected to consist of compact soils.

4.2 Frost Penetration

Based on climate data and design charts, the maximum frost penetration depth below the pavement at the site is estimated at 1.2 mbeg.

Footings for the proposed structure should be situated at or below this depth for frost protection or should be protected with insulation. It is noted that footings on clean,



unweathered limestone bedrock that is free of silt and clay seams will not be susceptible to frost movement.

It is assumed that the pavement structure thickness will be less than 1.2 m, so grading and drainage are important for good pavement performance and life expectancy. Any services/utilities should be located below this depth or be appropriately insulated.

4.3 Excavations and Shoring

All excavations must be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA). The generally loose to compact fill and native silt and sand soils may be classified as Type 3 soils above the groundwater table in accordance with OHSA. Type 3 soils may be excavated with unsupported side slopes no steeper than 1H:1V. Below the groundwater table these soils may be classified as Type 4 soils and may be excavated with unsupported side slopes no steeper than 3H:1V.

Test excavations should be carried out at the time of construction to assess the soil integrity and water levels to determine any shoring requirements.

Excavation side slopes should be protected from exposure to precipitation and associated ground surface runoff and should be inspected regularly for signs of instability. If localized instability is noted during excavation or if wet conditions are encountered, the side slopes should be flattened as required to maintain safe working conditions or the excavation sidewalls must be fully supported (shored).

4.4 Dewatering

Based on observations, most soils encountered within the required excavation depths are brown and moist. Monitoring well measurement and water levels on completion of each borehole provide evidence of a water level ranging from approximately 1.6 mbeg to 2.6 mbeg. The moisture content and brown colour of soil samples, encountered at the time of investigation, support these findings. The elevated water level, into elevations of brown soil, are likely due to seasonally high water levels or water perched on top of the bedrock.



Depending on the time of year and precipitation, upon excavation, the depth of the groundwater table at the Site may be between or below the elevations mentioned here.

Assuming that construction is to occur in a drier season, significant groundwater seepage is not anticipated within the excavation depths. Any seepage within the excavation depths should be controllable with filtered sumps and pumps and a Permit to Take Water (PTTW) or registry in the Environmental Activity and Sector Registry for the Ministry of the Environment, Conservation, and Parks (MOECP) will not be required.

Should construction be carried out after prolonged periods of rainfall, or under generally wet conditions, groundwater may be elevated and pose greater problems, whereby the rate of seepage into the proposed excavations may be greater than 50,000 L/day, and the requirement of registering the construction dewatering in the MOECC's EASR may be necessary. As such, some sections of excavation may require more advanced dewatering efforts such as sumps and filtered pumps in order to lower the local groundwater table prior to construction.

It should be noted that the groundwater table is influenced by seasonal fluctuations and major precipitation events. Consideration should be given to measuring water levels in the installed groundwater monitors several times prior to construction to obtain more information on seasonal groundwater levels. A test excavation would also be useful prior to construction to determine groundwater conditions at the time of construction.

4.5 Backfill and Compaction

Excavated topsoil from the Site is not appropriate for use as fill below grading and parking areas. Excavated sand, silt and sand, and sand and gravel, not containing organics or any other deleterious material, may be appropriate for use as fill below grading and parking areas, provided that the actual or adjusted moisture content at the time of construction is within a range that permits compaction to required densities. Some moisture content adjustments may be required depending upon seasonal conditions. Geotechnical inspections and testing of engineered fill are required to confirm acceptable quality.



Any engineered fill below foundations should be placed in lifts appropriate to the type of compaction equipment used on site and be compacted to a minimum of 100% of standard Proctor maximum dry density (SPMDD), as confirmed by nuclear densometer testing. If native soils from the site are not used as engineered fill, imported material for engineered fill should consist of clean, non-organic soils, free of chemical contamination or deleterious material. The moisture content of the engineered fill will need to be close enough to optimum at the time of placement to allow for adequate compaction. Consideration could be given to using a material meeting the specifications of OPSS 1010 Granular B.

Foundation wall and any buried utility backfill material should consist of free-draining imported granular material. Most of the native site soils are too fine-grained to provide proper drainage, and as such this should be accomplished using well graded Granular B Type 1 material complying with OPSS 1010. The fill should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95 SPMDD, taking care not to damage any utility pipes during compaction.

The backfill material, if any, in the upper 300 mm below the pavement subgrade elevation should be compacted to 100 percent of SPMDD in all areas.

4.6 Foundation Design

It is understood that the proposed structure is to be 1-2 storeys with high volume apparatus bays and support spaces including offices and accommodations. The structure is not to have a basement and is to be slab-on-grade construction.

Assuming that the site is prepared as outlined above, the native bedrock is competent to support the proposed structures on conventional strip and spread footings. For the structure, all footings should be on bedrock or all footings on a minimum thickness of 300 mm of engineered fill to prevent differential settlement. Native soils are not adequate to support the structure. If exterior footings are not placed directly on bedrock, they should be placed a minimum of 1.2 m below final grade for frost protection.



Any required grade raises to the footing elevations can be accomplished with engineered fill, using an OPSS 1010 SSM or Granular 'B' Type I granular material in 200 mm lifts and compacted to a minimum of 100% of Standard Proctor Maximum Dry Density (SSPMD). If raises are used, a minimum of 300 mm of engineered fill should be used under all footings.

Footings set in engineered fill extending to unweathered limestone bedrock may be designed to an allowable bearing capacity of 200 kPa at SLS, 300 kPa ULS. Any footings set on competent, unweathered, in-situ bedrock may be designed to an allowable bearing capacity of 700 kPa at ULS. Depending on the degree of weathering, a bearing capacity of 300 kPa may be provided at depths below 1.2 m, which will be confirmed upon inspection. For footings on bedrock settlement is not a concern as it will be negligible. Settlement potential at the noted SLS loadings in engineered fill is less than 25 mm and differential settlement should be less than 10 mm.

The quality of the bedrock subgrade shall be inspected by Cambium during construction, prior to constructing the footings and placing engineered fill, to confirm bearing capacity estimates.

4.7 Floor Slabs

Inorganic native soils at the site are considered competent to support floor slab loads at the proposed depths. Native soils should be compacted prior to placing engineered fill. Locally, some areas, may require excavation to compact soils and backfilling with engineered fill to the intended grade, as outlined in Section 4.5. To create a stable working surface and to distribute loadings, shallow floor slabs should be constructed on a minimum of 600 mm of OPSS Granular A, compacted as outlined in Section 4.5.

4.8 Seismic Site Classification

The Ontario Building Code (OBC) specifies that structures should be designed to withstand forces due to earthquakes. For the purpose of earthquake design, geotechnical information shall be used to determine the "Site Class". Based on the explored soil properties and in accordance with Table 4.1.8.4.A of the OBC (2006), Site Class 'C' (very dense soil and soft rock) should be applied for structural design with conventional footings on soil or bedrock. It



may be possible to upgrade the site class to 'Class B' for the proposed building, subject to Sear Wave Velocity Testing. A detailed report of the 2015 National Building Code Seismic Hazard Values including Peak ground acceleration and spectral acceleration (period of 0.2 seconds) for the Site can be found in Appendix E.

4.9 Subdrainage

Wet conditions were observed on Site at depths below 0.76 mbeg, at the time of the investigation. It should be noted that groundwater levels are affected by seasonal climatic conditions, and as such, groundwater levels are expected to be at higher levels during seasonally wet periods. Based on this information, and the proposed elevation of the floor slab of the home, subdrainage is not required. Should conditions be dissimilar at the time of development, areas that encounter the water table during the floor slab and footing excavations, geotextile wrapped perforated pipe subdrains set in a trench of clear stone and connected to a sump or other frost-free positive outlet, are recommended around all footings and underneath the floor slabs. In this case, it is important that the slab and any foundation walls be waterproofed.

4.10 Lateral Earth Pressure

Lateral earth pressure coefficients (K) for foundation and retaining wall design are provided below. It is assumed that potential lateral loads will result from cohesionless, frictional materials, such as granular backfill.

Ko (at rest)	0.42
Ka (active)	0.27
Kp (passive)	3.7

The following formula may be used to calculate active lateral thrust (Pa) on yielding retaining structures;

$$Pa = (H/2)(Ka)(\gamma H + 2q)$$

where,

$$H = \text{Height of retaining structure (m)}$$



γ = unit weight of retained soil (kN/m³)

q = surcharge (kPa)

A unit weight of 22 kN/m³ should be assumed for compacted granular backfill loadings.

4.11 Corrosivity

Two (2) soil samples were submitted to CALA certified Caduceon Laboratories for chemical corrosivity analysis. The laboratory results are presented in Appendix D. The samples were analyzed for chloride, sulphate, pH, electrical conductivity, resistivity, redox potential, and sulphide concentrations. The submitted samples were taken from boreholes BH104-21 and BH105-21, at depths of 0 mbeg to 2.7 mbeg and 0 mbeg to 1.2 mbeg, respectively.

To determine the potential for corrosion, the laboratory results were compared to the ANSI/AWWA corrosivity rating system. Points with a total of 10 or more indicate that the soil is likely corrosive to cast iron alloys and corrosion protection measures are recommended. Based on the tested results, the sample from BH105-21 is considered to pose a relatively moderate potential corrosivity to ductile iron pipe. Provision of recommendations for corrosion protection is beyond the scope of this investigation.



Table 4 Corrosivity Results

Parameter	BH104-21 Test Results	BH105-21 Test Results
Resistivity ($\Omega \cdot \text{cm}$)	7,290	289
pH	7.58	7.56
Redox Potential (mV)	287	270
Sulphide ($\mu\text{g/g}$)	0.7	0.7
Moisture Content	Fair	Fair
Sulphate ($\mu\text{g/g}$)	20	50
Chloride ($\mu\text{g/g}$)	5	2140

The laboratory test results also indicate that the sulphates concentration of the tested sample is approximately 20 to 50 mg/L. Based on this concentration, there is a negligible potential for sulphate attack on concrete. Accordingly, General Use (GU) Portland cement can be used for the concrete structures below grade.

It is noted that the chloride concentration in the sample from BH105-21 was high. The exact source of the chloride and the extent is not known. Consideration could be given to delineating the extent of the high chloride levels or mitigating any concerns by increasing reinforcing steel cover by 25 mm and/or using epoxy coated rebar.

4.12 Pavement Design

The performance of the pavement is dependent upon proper subgrade preparation. All topsoil and organic materials should be removed down to native material and backfilled with approved engineered fill or native material, compacted to 98 percent SPMDD. The subgrade should be proof rolled and inspected by a Geotechnical Engineer. Any areas where rutting or appreciable deflection is noted should be subexcavated and replaced with suitable fill. The fill should be compacted to at least 98 percent SPMDD.



In order to completely protect against damage due to frost heaving, excavations should be made to the maximum frost penetration depth and backfilled with free-draining granular material.

In an attempt to reduce costs an alternative pavement structure design is proposed. It should be noted that while the designs presented will provide adequate support for the intended use, some frost heaving may persist, resulting in minor degradation and minimal annual maintenance.

The recommended minimum pavement structure design has been developed assuming the Site will have frequent heavy truck traffic, and other areas with limited heavy truck traffic. The recommended minimum pavement structure is provided in Table 5. If the parking areas are not to be asphalt surfaced it is recommended that the thickness of the Granular A base be increased to 300 mm.

Table 5 Recommended Minimum Pavement Structure

Pavement Layer	Heavy Duty (1)	Heavy Duty (2)	Medium Duty (light vehicle parking)
Surface Course Asphalt	40 mm HL3 or HL4	40 mm Superpave SP 12.0 FC1 or Equivalent	40 mm HL3 or HL4
Binder Course Asphalt	90 mm HL8 (2 lifts)	60 mm Superpave SP 12.0 FC1 or Equivalent	50 mm HL8
Granular Base	150 mm OPSS 1010 Granular A	200 mm OPSS 1010 Granular A	150 mm OPSS 1010 Granular A
Granular Subbase	350 mm OPSS 1010 Granular B	500 mm OPSS 1010 Granular B	350 mm OPSS 1010 Granular B

Heavy Duty (1) incorporates a 130 mm thickness of asphalt. Alternately, Heavy Duty (2) has been modified with a 200 mm increase in granular base and subbase, which has allowed for a reduction in asphalt thickness to 100 mm. Note that due to the thinner nature of the asphalt and likelihood of heavy trucks turning on the asphalt, a higher quality, Superpave mix has been indicated for Heavy Duty (2) in Table 5.

Material and thickness substitutions must be approved by the Design Engineer.



The thickness of the subbase layer could be increased at the discretion of the Engineer, to accommodate site conditions at the time of construction, including soft or weak subgrade soil replacement.

Compaction of the subgrade should be verified by the Engineer prior to placing the granular fill. Granular layers should be placed in 150 mm maximum loose lifts and compacted to at least 98 percent of SPMDD (ASTM D698) standard. The granular materials specified should conform to OPSS standards, as confirmed by appropriate materials testing.

Consideration should be given to the use of a geogrid between the granular base and subbase of the Heavy-Duty design, in areas where repeated turning is expected. The geogrid will help to maintain the pavement structure in areas subject to the stress of repetitive turning.

The final asphalt surface should be sloped at a minimum of 2 percent to shed runoff. Any abutting pavements should be sawcut to provide clean vertical joints with new pavement areas.

4.13 Buried Utilities

Where required, trench excavations should generally consider Type 3 soil conditions which allow for excavation side slopes no steeper than 1H:1V.

Any services/utilities should be located 1.2 m below final grade or be appropriately insulated.

Bedding and cover material for any services should consist of OPSS 1010-3 Granular A or B Type II, placed in accordance with pertinent Ontario Provincial Standard Drawings (OPSD 802.013). The bedding and cover material shall be placed in maximum 200 mm thick lifts and should be compacted to at least 98 percent of SPMDD. The cover material shall be a minimum of 300 mm over the top of the pipe and compacted to 98 percent of SPMDD, taking care not to damage the utility pipes during compaction. In wet conditions where compaction of Granular A or B is not possible, 19 mm diameter crushed clear stone wrapped in a geotextile filter fabric should be used for bedding.



4.14 Design Review and Inspections

Testing and inspections should be carried out during construction operations to examine and approve subgrade conditions, placement and compaction of fill materials, and dewatering requirements. Concrete used during construction should also be tested for slump, air entrainment and compressive strength.

We should be contacted to review and approve design drawings, prior to tendering or commencing construction, to ensure that all pertinent geotechnical-related factors have been addressed. It is important that onsite geotechnical supervision be provided at this site for excavation and backfill procedures, deleterious soil removal, subgrade inspections and compaction and concrete testing.



5.0 Closing

We trust the information in this report is sufficient for your current needs. If you have questions or comments regarding this document, please do not hesitate to contact Mr. Baird at (705) 742-7900 ext. 332 or Mr. Peterkin at ext. 301.

Respectfully submitted,

Cambium Inc.

Stuart Baird, P.Eng.
General Manager -
Geotechnical

Brian Peterkin, M.Eng., P.Geo
Senior Project Manager.

SEB/bjp

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6.0 Standard Limitations

Limited Warranty

In performing work on behalf of a client, Cambium relies on its client to provide instructions on the scope of its retainer, and, on that basis, Cambium determines the precise nature of the work to be performed. Cambium undertakes all work in accordance with applicable accepted industry practices and standards. Unless required under local laws, other than as expressly stated herein, no other warranties or conditions, either expressed or implied, are made regarding the services, work or reports provided.

Reliance on Materials and Information

The findings and results presented in reports prepared by Cambium are based on the materials and information provided by the client to Cambium and on the facts, conditions and circumstances encountered by Cambium during the performance of the work requested by the client. In formulating its findings and results into a report, Cambium assumes that the information and materials provided by the client or obtained by Cambium from the client or otherwise are factual, accurate and represent a true depiction of the circumstances that exist. Cambium relies on its client to inform Cambium if there are changes to any such information and materials. Cambium does not review, analyze, or attempt to verify the accuracy or completeness of the information or materials provided, or circumstances encountered, other than in accordance with applicable accepted industry practice. Cambium will not be responsible for matters arising from incomplete, incorrect, or misleading information or from facts or circumstances that are not fully disclosed to or that are concealed from Cambium during the provision of services, work, or reports.

Facts, conditions, information, and circumstances may vary with time and locations and Cambium's work is based on a review of such matters as they existed at the particular time and location indicated in its reports. No assurance is made by Cambium that the facts, conditions, information, circumstances, or any underlying assumptions made by Cambium in connection with the work performed will not change after the work is completed and a report is submitted. If any such changes occur or additional information is obtained, Cambium should be advised and requested to consider if the changes or additional information affect its findings or results.

When preparing reports, Cambium considers applicable legislation, regulations, governmental guidelines, and policies to the extent they are within its knowledge, but Cambium is not qualified to advise with respect to legal matters. The presentation of information regarding applicable legislation, regulations, governmental guidelines, and policies is for information only and is not intended to and should not be interpreted as constituting a legal opinion concerning the work completed or conditions outlined in a report. All legal matters should be reviewed and considered by an appropriately qualified legal practitioner.

Site Assessments

A site assessment is created using data and information collected during the investigation of a site and based on conditions encountered at the time and particular locations at which fieldwork is conducted. The information, sample results and data collected represent the conditions only at the specific times at which and at those specific locations from which the information, samples and data were obtained and the information, sample results and data may vary at other locations and times. To the extent that Cambium's work or report considers any locations or times other than those from which information, sample results and data was specifically received, the work or report is based on a reasonable extrapolation from such information, sample results and data but the actual conditions encountered may vary from those extrapolations.

Only conditions at the site and locations chosen for study by the client are evaluated; no adjacent or other properties are evaluated unless specifically requested by the client. Any physical or other aspects of the site chosen for study by the client, or any other matter not specifically addressed in a report prepared by Cambium, are beyond the scope of the work performed by Cambium and such matters have not been investigated or addressed.

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Cambium's services, work and reports may be relied on by the client and its corporate directors and officers, employees, and professional advisors. Cambium is not responsible for the use of its work or reports by any other party, or for the reliance on, or for any decision which is made by any party using the services or work performed by or a report prepared by Cambium without Cambium's express written consent. Any party that relies on services or work performed by Cambium or a report prepared by Cambium without Cambium's express written consent, does so at its own risk. No report of Cambium may be disclosed or referred to in any public document without Cambium's express prior written consent. Cambium specifically disclaims any liability or responsibility to any such party for any loss, damage, expense, fine, penalty or other such thing which may arise or result from the use of any information, recommendation or other matter arising from the services, work or reports provided by Cambium.

Limitation of Liability

Potential liability to the client arising out of the report is limited to the amount of Cambium's professional liability insurance coverage. Cambium shall only be liable for direct damages to the extent caused by Cambium's negligence and/or breach of contract. Cambium shall not be liable for consequential damages.

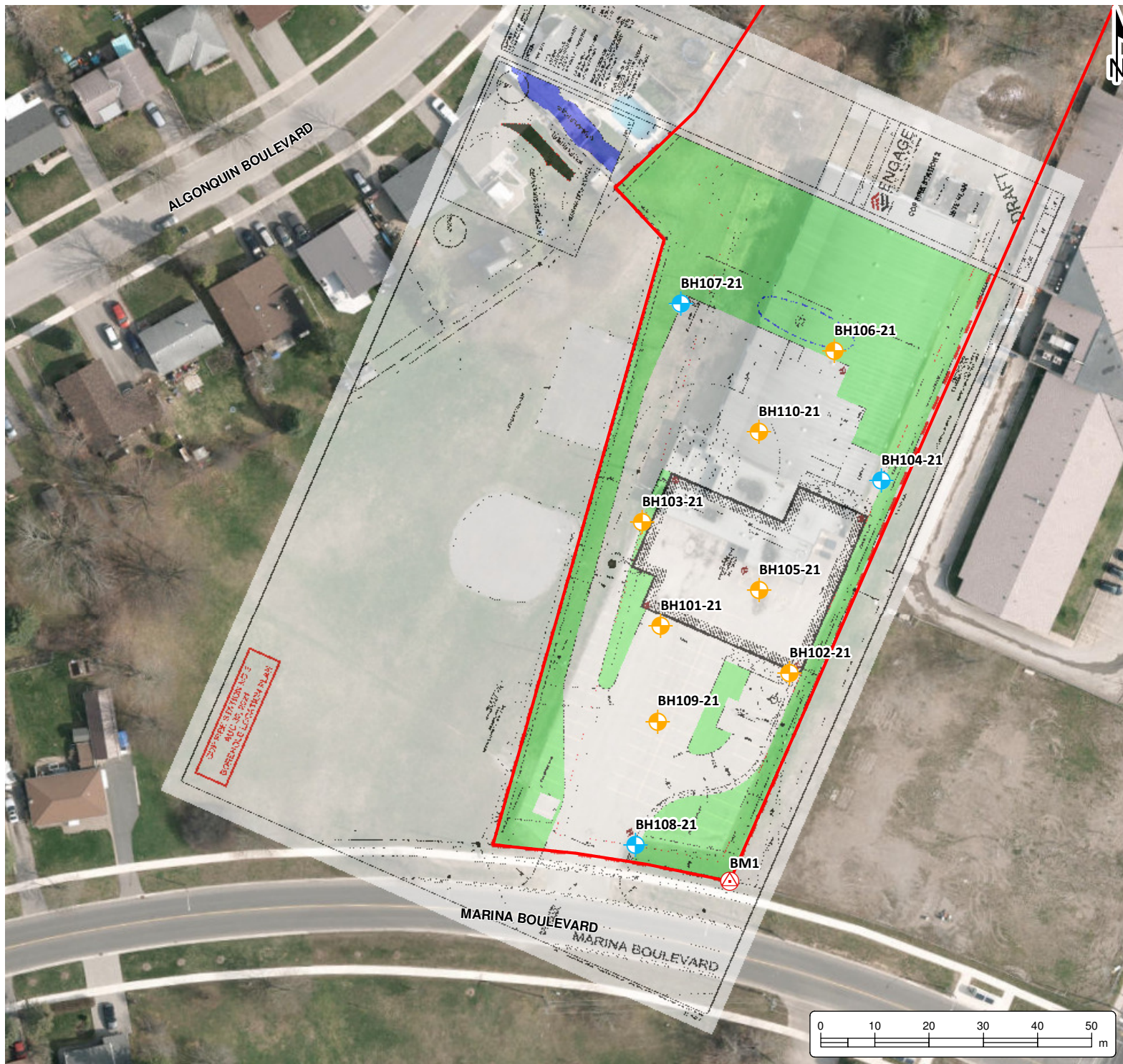
Personal Liability

The client expressly agrees that Cambium employees shall have no personal liability to the client with respect to a claim, whether in contract, tort and/or other cause of action in law. Furthermore, the client agrees that it will bring no proceedings nor take any action in any court of law against Cambium employees in their personal capacity.



Appended Figures

O:\GIS\MXDs\13500-13599\13544-003 City of Peterborough - Fire Station 2 Northcrest/Arena Site\2021-09-30 FIG 1 - Proposed Borehole Plan.mxd



GEOTECHNICAL INVESTIGATION

THE CITY OF PETERBOROUGH
100 Marina Boulevard
Peterborough, Ontario

- LEGEND**
- Benchmark
 - Borehole
 - Monitoring Well
 - Site (approximate)

Notes:

- Overlay image is COP Fire Station 2 Site Plan, by Engage Engineering, for the City of Peterborough, Project no. 21015, dated Aug. 16, 2021.
- Site is approximate and was obtained from the City of Peterborough online GIS.
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

Benchmarks:

BM1 - An iron bar located on the south east property corner with a known elevation of 211.02 masl.

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BOREHOLE LOCATION PLAN

Project No.:	13544-003	Date:	September 2021
Scale:	1:1,000	Projection:	NAD 1983 UTM Zone 17N
Created by:	MAT	Checked by:	BP
			1



Appendix A
Borehole Logs



Client: City of Peterborough **Project Name:** Fire Station 2 Northcrest Arena Site **Project No.:** 13544-003
Contractor: Canadian Environmental **Method:** Solid Stem Auger and Rock Core **Date Completed:** October 4, 2021
Location: 100 Marina Blvd, Peterborough, ON **UTM:** 17T 713942.244 m E, 4912650.481 m N **Elevation:** 212.357 masl

SUBSURFACE PROFILE			SAMPLE							Well Installation	Remarks			
Elevation (m)	Depth (m)	Lithology	Description	Number	Type	% Recovery / TCR (%)	SPT (N) / RQD (%)	% Moisture				SPT (N)		
								25	50	75	10	20	30	40
0		ASPHALT	50mm thick asphalt	1A	SS									
212		SAND AND GRAVEL	Brown, sand and gravel, some silt	1B	SS	80	9							
		SAND AND SILT	Brown, sand and silt, some gravel, trace rootlets, moist to wet, very loose											
1		GRAVELLY SAND	Brown, gravelly sand, some silt, trace rootlets, moist to wet, very loose	2	SS	100	50/100							
211		BEDROCK	Grey, streaked dark grey, limestone, fine to medium grained, slightly weathered, thinly bedded soft rock, smooth, poor quality RQD											
2			-becomes fine to medium grained	1	RC	94	43							
210			-20mm thick seam of brown, shattered silty clay -20mm thick seam of brown, shattered silty clay -becomes coarse grained											
3			-20mm thick seam of brown, shattered silty clay -becomes fine to medium grained, fair quality RQD											
209			-20mm thick seam of grey/brown, shattered silty clay	2	RC	100	53							
4			-20mm thick seam of grey/brown, shattered silty clay											
208			Borehole terminated at 4.11 mbgs in limestone bedrock											
5														
207														
6														
206														

Borehole open and dry upon completion

Bedrock was encountered at 0.86 mbgs



Client: City of Peterborough **Project Name:** Fire Station 2 Northcrest Arena Site **Project No.:** 13544-003
Contractor: Canadian Environmental **Method:** Solid Stem Auger and Rock Core **Date Completed:** October 4, 2021
Location: 100 Marina Blvd, Peterborough, ON **UTM:** 17T 713966.004 m E, 4912641.762 m N **Elevation:** 212.488 masl

SUBSURFACE PROFILE			SAMPLE							Well Installation	Remarks			
Elevation (m)	Depth (m)	Lithology	Description	Number	Type	% Recovery / TCR (%)	SPT (N) / RQD (%)	% Moisture				SPT (N)		
								25	50	75	10	20	30	40
0		ASPHALT	50mm thick asphalt	1A	SS									
		SAND AND GRAVEL	Brown, sand and gravel, some silt, moist, compact	1B	SS	70	16							
212		SANDY SILT	Brown, sandy silt, moist, compact											
		SAND	Brown, sand, some silt, trace gravel, moist, loose	2A	SS									
				2B	SS	70	8							
211		SILT AND SAND	Dark brown, silt and sand, trace gravel, moist, very loose	3A	SS									
				3B	SS									
						33	3							
210		BEDROCK	Grey, streaked dark grey, limestone, fine to medium grained, slightly weathered, thinly bedded soft rock, smooth, poor quality RQD	4	SS	30	50/150							
			-becomes coarse grained											
209			-becomes fine to medium grained	1	RC	100	40							
208			-becomes coarse grained											
207			-becomes fine to medium grained	2	RC	100	44							
			-becomes coarse grained											
			-becomes fine to medium grained											
6			Borehole terminated at 5.69 mbgs in limestone bedrock											

SS3B GSA:
 9% gravel
 38% sand
 53% silt & clay

Bedrock was encountered at 2.49 mbgs

Borehole open and dry upon completion




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Log of Borehole:

BH103-21

Page 1 of 1

Client: City of Peterborough **Project Name:** Fire Station 2 Northcrest Arena Site **Project No.:** 13544-003
Contractor: Canadian Environmental **Method:** Solid Stem Auger **Date Completed:** October 4, 2021
Location: 100 Marina Blvd, Peterborough, ON **UTM:** 17T 713938.842 m E, 4912669.703 m N **Elevation:** 212.284 masl

SUBSURFACE PROFILE			SAMPLE							Well Installation	Remarks			
Elevation (m)	Depth (m)	Lithology	Description	Number	Type	% Recovery / TCR (%)	SPT (N) / RQD (%)	% Moisture				SPT (N)		
								25	50	75	10	20	30	40
212	0		SILT AND SAND: Brown, silt and sand, some gravel, wet, loose	1	SS	20	4							
211	1		Borehole terminated at 0.76 mbgs on presumed bedrock	2	SS	50	50/75							
210	2													
209	3													
208	4													
207	5													
206	6													

Borehole open and dry upon completion



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Log of Borehole:

BH105-21

Page 1 of 1

Client: City of Peterborough **Project Name:** Fire Station 2 Northcrest Arena Site **Project No.:** 13544-003
Contractor: Canadian Environmental **Method:** Solid Stem Auger **Date Completed:** October 5, 2021
Location: 100 Marina Blvd, Peterborough, ON **UTM:** 17T 713960.433 m E, 4912657.153 m N **Elevation:** 212.356 masl

SUBSURFACE PROFILE			SAMPLE							Well Installation	Remarks			
Elevation (m)	Depth (m)	Lithology	Description	Number	Type	% Recovery / TCR (%)	SPT (N) / RQD (%)	% Moisture				SPT (N)		
								25	50	75	10	20	30	40
0		ASPHALT	50mm thick asphalt	1A	SS									
212		SILTY SAND	Brown, silty sand, trace gravel, moist, compact	1B	SS	75	13							
		SANDY SILT	Light brown, sandy silt, moist to wet, compact											
1		SAND	Brown, sand (coarse), some silt, trace gravel, moist, compact	2	SS	67	14							
211			-some gravel	3	SS	20	50/350							
2			Borehole terminated at 1.83 mbgs on presumed bedrock											
210														
3														
209														
4														
208														
5														
207														
6														
206														

Borehole open and dry upon completion



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Log of Borehole:

BH106-21

Page 1 of 1

Client: City of Peterborough **Project Name:** Fire Station 2 Northcrest Arena Site **Project No.:** 13544-003
Contractor: Canadian Environmental **Method:** Hand SPT **Date Completed:** October 6, 2021
Location: 100 Marina Blvd, Peterborough, ON **UTM:** 17T 713960.217 m E, 4912686.366 m N **Elevation:** 211.6216 masl

SUBSURFACE PROFILE			SAMPLE							Well Installation	Remarks					
Elevation (m)	Depth (m)	Lithology	Description	Number	Type	% Recovery / TCR (%)	SPT (N) / RQD (%)	% Moisture				SPT (N)				
								25	50	75	10	20	30	40		
211	0		SAND: Light brown, sand (fine), some silt, some gravel, dry to moist, dense	1	SS	90		26								
	33															
	33															
	29															
	1				SAND AND GRAVEL: Brown, sand and gravel, some silt, moist, dense	2	SS	80		21						
	32															
	37															
	210			3	SS	80		36								
		29														
		35														
	2	Borehole terminated at 1.83 mbgs in sand and gravel						27								
	209							22								
	3															
	208															
	4															
	207															
	5															
	206															
	6															

Borehole open and dry upon completion

SS3 GSA:
 43% gravel
 47% sand
 10% silt & clay



Client: City of Peterborough **Project Name:** Fire Station 2 Northcrest Arena Site **Project No.:** 13544-003
Contractor: Canadian Environmental **Method:** Solid Stem Auger **Date Completed:** October 5, 2021
Location: 100 Marina Blvd, Peterborough, ON **UTM:** 17T 713946.015 m E, 4912710.03 m N **Elevation:** 212.813 m N

SUBSURFACE PROFILE			SAMPLE							Well Installation	Remarks	
Elevation (m)	Depth (m)	Lithology	Description	Number	Type	% Recovery / TCR (%)	SPT (N) / RQD (%)	% Moisture	SPT (N)			
								25 50 75	10 20 30 40			
0	0	TOPSOIL: 300 mm Topsoil: Dark brown, silt, trace sand, some organics		1A	SS	75	8					Water level measured at 1.95 mbgs on 2021-12-14 SS3 GSA: 63% gravel 25% sand 12% silt & clay
		SILT: Dark brown, silt, some gravel, moist, loose		1B	SS							
212	1	SANDY SILT: Brown, sandy silt, some gravel, moist, loose		2	SS	40	5					
211	2	SANDY GRAVEL: Brown, sandy gravel, some silt, moist, compact		3	SS	30	16					
210	3	Borehole terminated at 2.59 mbgs on presumed bedrock		4	SS	30	50/250					Borehole open and dry upon completion
209	4											
208	5											
207	6											



Client: City of Peterborough **Project Name:** Fire Station 2 Northcrest Arena Site **Project No.:** 13544-003
Contractor: Canadian Environmental **Method:** Solid Stem Auger **Date Completed:** October 5, 2021
Location: 100 Marina Blvd, Peterborough, ON **UTM:** 17T 713937.608 m E, 4912610.073 m N **Elevation:** 212.564 masl

SUBSURFACE PROFILE			SAMPLE							Well Installation	Remarks			
Elevation (m)	Depth (m)	Lithology	Description	Number	Type	% Recovery / TCR (%)	SPT (N) / RQD (%)	% Moisture				SPT (N)		
								25	50	75	10	20	30	40
0			TOPSOIL: 200mm Topsoil	1A	SS									
			SAND AND GRAVEL: Brown/grey, sand and gravel, trace silt, moist, compact	1B	SS	67	19							
212			SAND: Brown, sand (coarse), trace gravel, trace silt, moist, compact	2	SS	50	13							
1			SILT AND SAND: Brown, silt and sand, trace gravel, wet, compact	3	SS	80	50/400							
211			Borehole terminated at 1.83 mbgs on presumed bedrock											
2														
210														
3														
209														
4														
208														
5														
207														
6														

Groundwater encountered at 1.52 mbgs

Water level measured at 1.52 mbgs upon completion

Water level measured at 1.40 mbgs on 2021-12-14

Caving occurred at 1.68 mbgs



Peterborough
 Barrie
 Oshawa
 Kingston
 T: 866-217-7900
 www.cambium-inc.com

Log of Borehole:

BH109-21

Page 1 of 1

Client: City of Peterborough **Project Name:** Fire Station 2 Northcrest Arena Site **Project No.:** 13544-003
Contractor: Canadian Environmental **Method:** Solid Stem Auger **Date Completed:** October 4, 2021
Location: 100 Marina Blvd, Peterborough, ON **UTM:** 17T 713941.733 m E, 4912632.823 m N **Elevation:** 212.533 masl

SUBSURFACE PROFILE				SAMPLE							Well Installation	Remarks			
Elevation (m)	Depth (m)	Lithology	Description	Number	Type	% Recovery / TCR (%)	SPT (N) / RQD (%)	% Moisture					SPT (N)		
								25	50	75	10	20	30	40	
0		ASPHALT: 25mm thick Asphalt													
212		SAND AND GRAVEL: Brown, sand and gravel, some silt, moist, compact		1	SS	60	19								SS2 GSA: 1% gravel 40% sand 59% silt & clay Groundwater encountered at 0.76 mbgs Caving occurred at 1.52 mbgs No noticeable water level was observed upon completion
	1	SILT AND SAND: Light brown, silt and sand, trace gravel, wet, compact		2	SS	35	20								
211				3	SS	100	50/75								
	2		Borehole terminated at 1.68 mbgs on presumed bedrock												
210															
	3														
209															
	4														
208															
	5														
207															
	6														

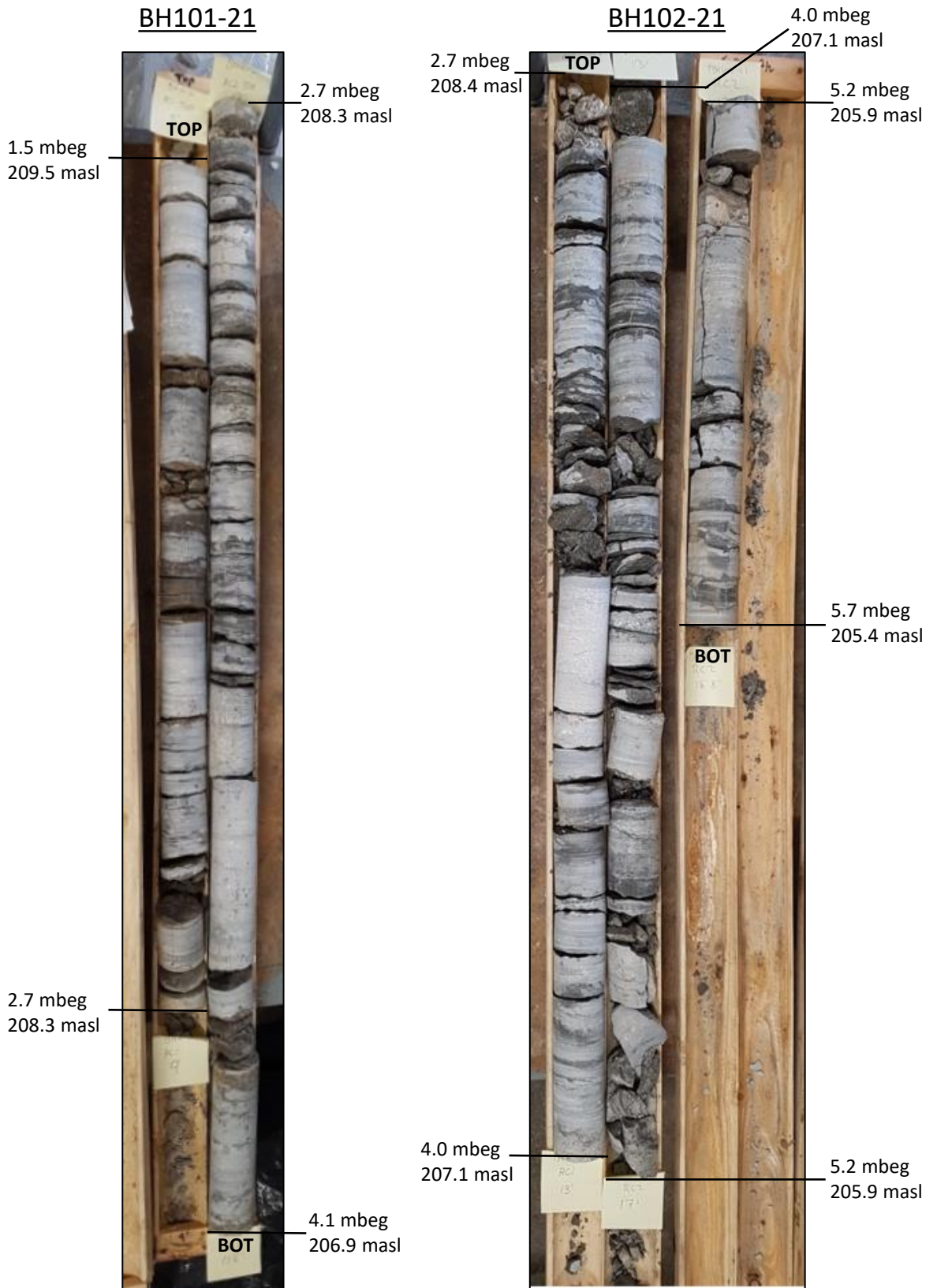
Logged By: J. Riseling

Input By: J. Riseling



Appendix B
Rock Core Photographs

Rock Cores





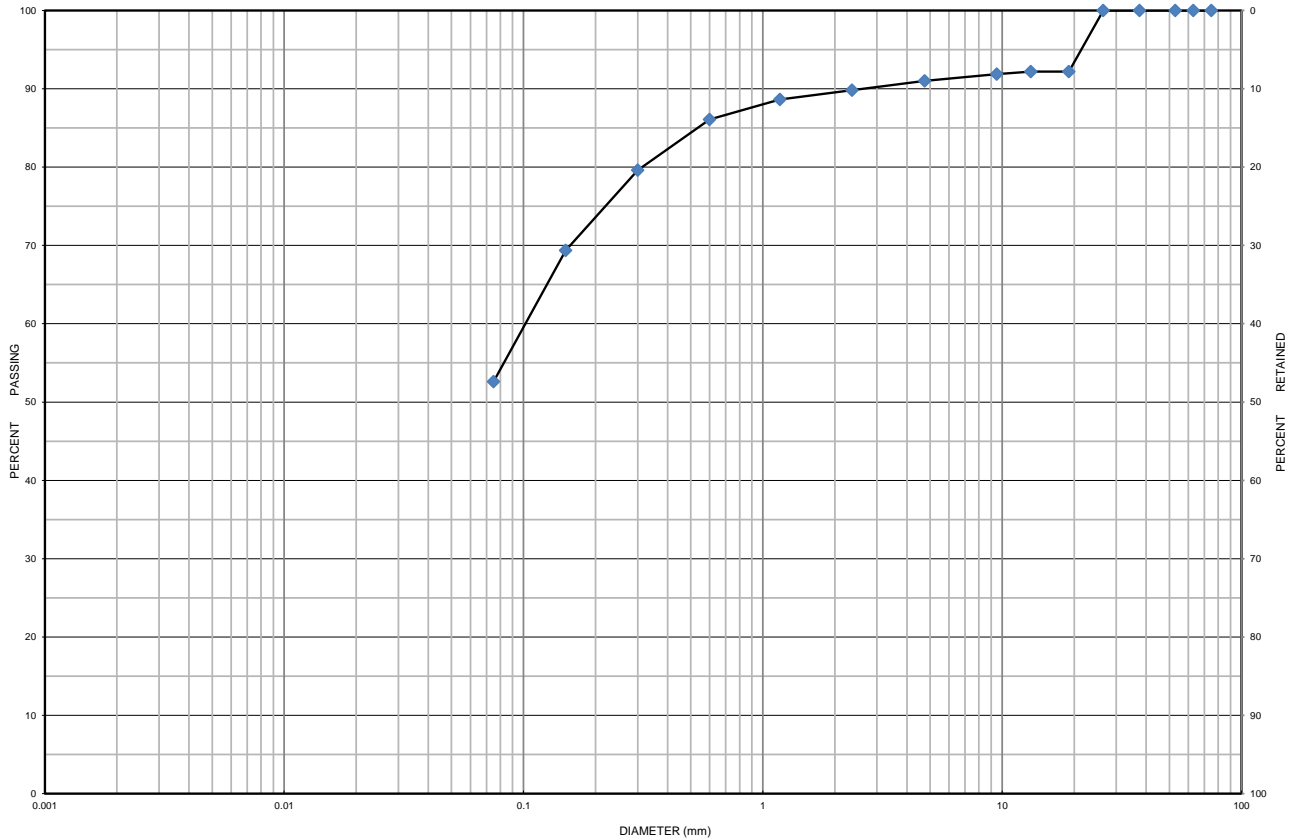
Appendix C
Physical Laboratory Testing Results



Grain Size Distribution Chart

Project Number: 13544-003 **Client:** City of Peterborough
Project Name: Geotechnical Investigation - Fire Station 2 Northcrest Arena Site
Sample Date: October 4 & 5, 2021 **Sampled By:** Josh Riseling - Cambium Inc.
Location: BH 102-21 SS 3B **Depth:** 1.6 m to 1.7 m **Lab Sample No:** S-21-1313

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 102-21	SS 3B	1.6 m to 1.7 m	9	38	53		26.6
Description		Classification	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
Silt and Sand trace Gravel		ML	0.110	-	-	-	-

Additional information available upon request

Issued By: *John Baird*
 (Senior Project Manager)

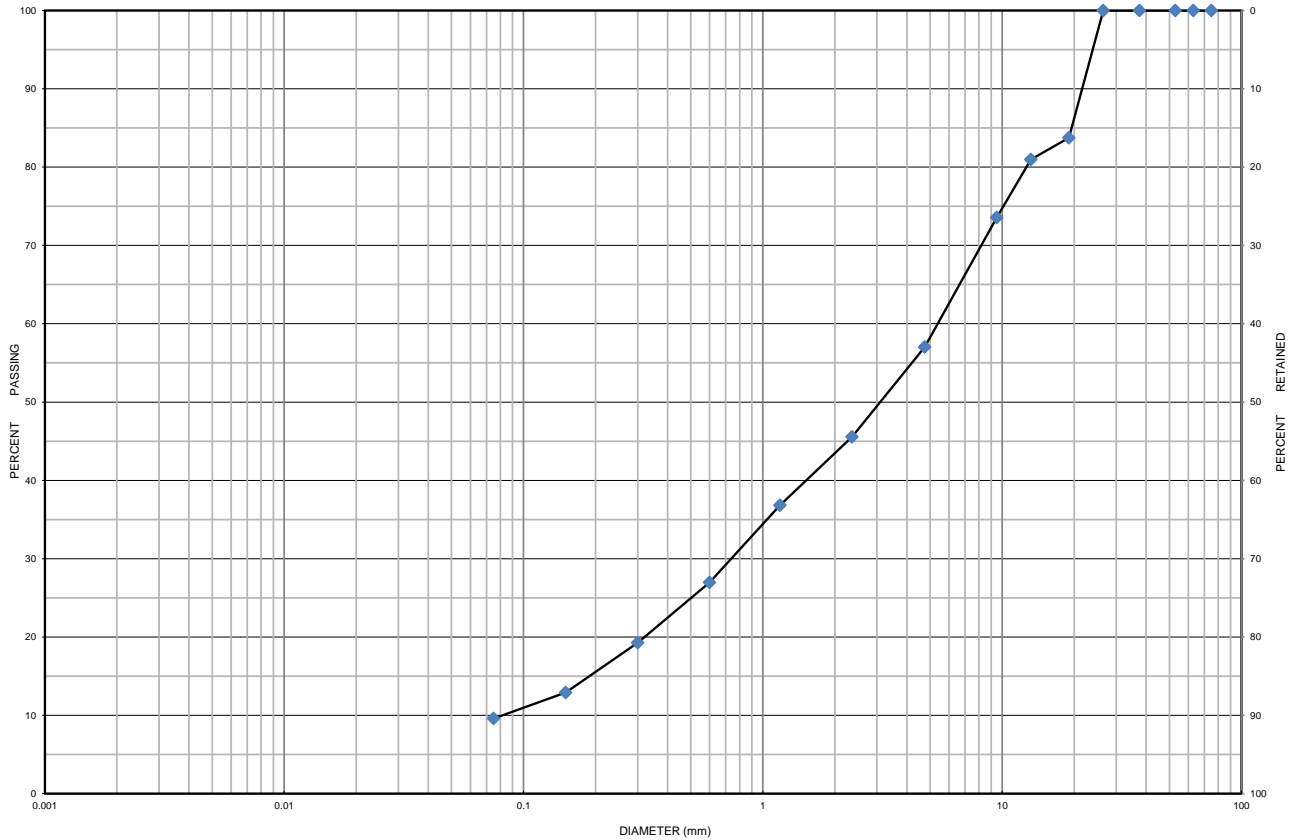
Date Issued: October 21, 2021



Grain Size Distribution Chart

Project Number: 13544-003 **Client:** City of Peterborough
Project Name: Geotechnical Investigation - Fire Station 2 Northcrest Arena Site
Sample Date: October 4 & 5, 2021 **Sampled By:** Josh Riseling - Cambium Inc.
Location: BH 106-21 SS 3 **Depth:** 1.2 m to 1.8 m **Lab Sample No:** S-21-1311

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 106-21	SS 3	1.2 m to 1.8 m	43	47	10		6.0
Description		Classification	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
Sand and Gravel some Silt		SW	5.350	0.740	0.080	66.88	1.28

Additional information available upon request

Issued By: *John Baird*
 (Senior Project Manager)

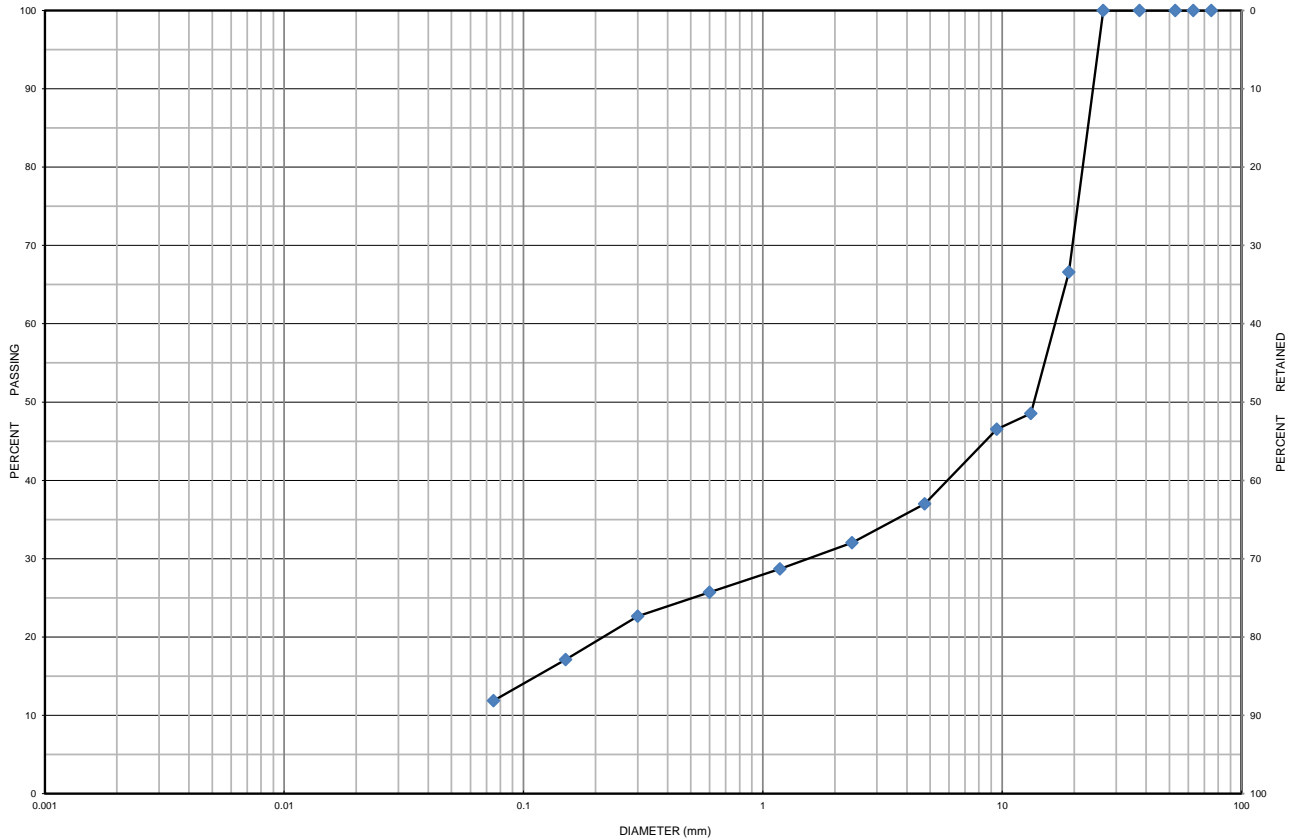
Date Issued: October 21, 2021



Grain Size Distribution Chart

Project Number: 13544-003 **Client:** City of Peterborough
Project Name: Geotechnical Investigation - Fire Station 2 Northcrest Arena Site
Sample Date: October 4 & 5, 2021 **Sampled By:** Josh Riseling - Cambium Inc.
Location: BH 107-21 SS 3 **Depth:** 1.5 m to 2 m **Lab Sample No:** S-21-1312

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 107-21	SS 3	1.5 m to 2 m	63	25	12		3.2
Description		Classification	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
Sandy Gravel some Silt		GP	10.700	1.600	-	-	-

Additional information available upon request

Issued By: *John Baird*
 (Senior Project Manager)

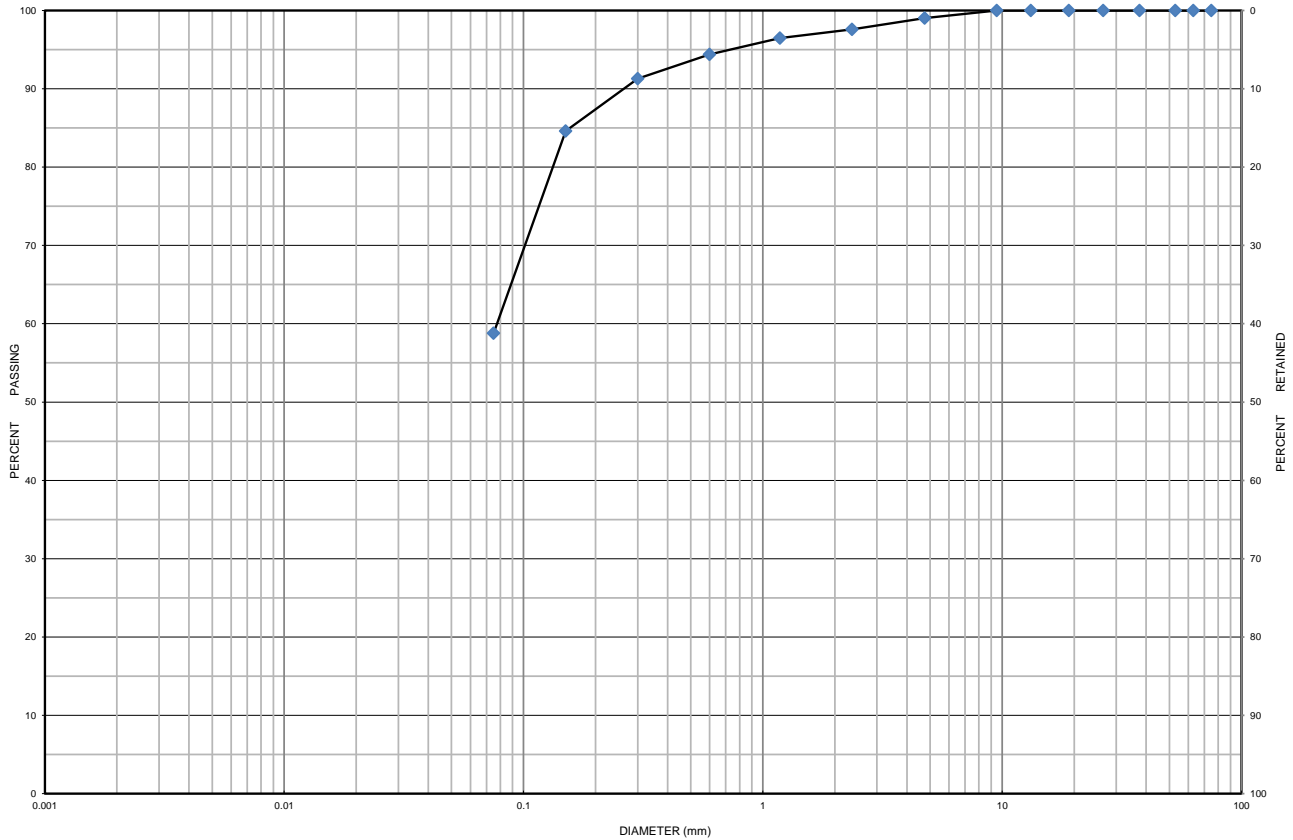
Date Issued: October 21, 2021



Grain Size Distribution Chart

Project Number: 13544-003 **Client:** City of Peterborough
Project Name: Geotechnical Investigation - Fire Station 2 Northcrest Arena Site
Sample Date: October 4 & 5, 2021 **Sampled By:** Josh Riseling - Cambium Inc.
Location: BH 109-21 SS 2 **Depth:** 0.8 m to 1.2 m **Lab Sample No:** S-21-1309

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 109-21	SS 2	0.8 m to 1.2 m	1	40	59		20.6
Description		Classification	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
Silt and Sand trace Gravel		ML	0.078	-	-	-	-

Additional information available upon request

Issued By: *John Baird*
 (Senior Project Manager)

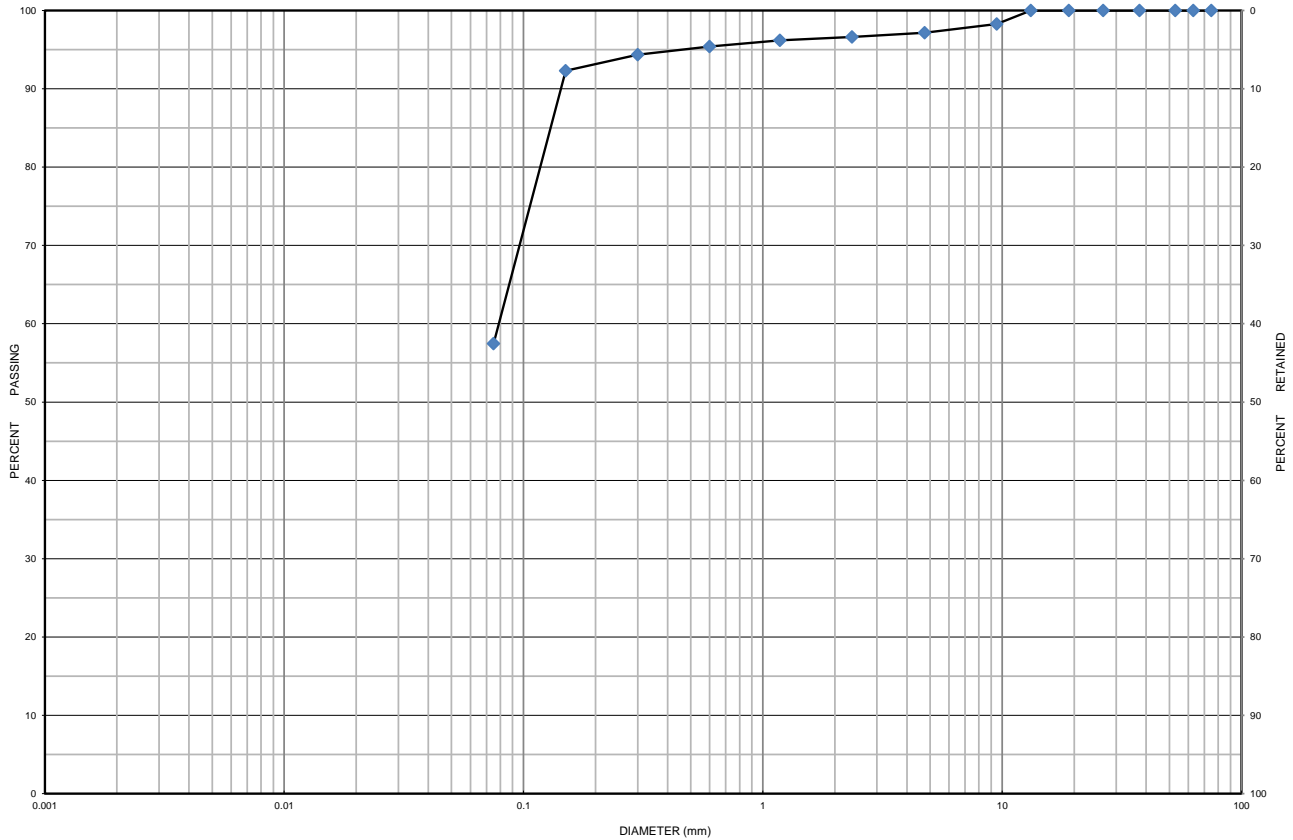
Date Issued: October 21, 2021



Grain Size Distribution Chart

Project Number: 13544-003 **Client:** City of Peterborough
Project Name: Geotechnical Investigation - Fire Station 2 Northcrest Arena Site
Sample Date: October 4 & 5, 2021 **Sampled By:** Josh Riseling - Cambium Inc.
Location: BH 110-21 SS 2B **Depth:** 0.8 m to 1 m **Lab Sample No:** S-21-1310

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 110-21	SS 2B	0.8 m to 1 m	3	40	57		20.4
Description		Classification	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
Silt and Sand trace Gravel		ML	0.079	-	-	-	-

Additional information available upon request

Issued By: *John Baird*
 (Senior Project Manager)

Date Issued: October 21, 2021



Appendix D
Corrosivity Analysis Results

C.O.C.: ---

REPORT No. B21-35693

Report To:

Cambium Environmental
 194 Sophia St.,
 Peterborough ON K9H 1E5 Canada

Attention: Brian Peterkin

Caduceon Environmental Laboratories

285 Dalton Ave
 Kingston Ontario K7K 6Z1
 Tel: 613-544-2001
 Fax: 613-544-2770

DATE RECEIVED: 29-Oct-21

JOB/PROJECT NO.: 13544-003

DATE REPORTED: 09-Nov-21

P.O. NUMBER: 13544-003

SAMPLE MATRIX: Soil

WATERWORKS NO.

Client I.D.	BH105-21 SS 1B&2	BH104-21 SS 1B&4		
Sample I.D.	B21-35693-1	B21-35693-2		
Date Collected	05-Oct-21	05-Oct-21		

Parameter	Units	R.L.	Reference Method	Date/Site Analyzed				
pH @25°C	pH Units		MOEE3530	01-Nov-21/R	7.56	7.58		
Conductivity @25°C	mS/cm	0.001	SM 2510B	03-Nov-21/O	3.46	0.137		
Resistivity	ohms-cm		SM 2510B	03-Nov-21/O	289	7290		
REDOX potential	mV		In-House	01-Nov-21/R	270	287		
Chloride	µg/g	5	SM4110C	04-Nov-21/O	2140	15		
Sulphate	µg/g	10	SM4110C	04-Nov-21/O	50	20		
Sulfide	µg/g	0.3	In-House	02-Nov-21	0.7	0.7		

1 Subcontracted to Testmark Labs



Michelle Dubien
 Lab Manager

R.L. = Reporting Limit

Test methods may be modified from specified reference method unless indicated by an *

Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from



Appendix E

2015 National Building Code Seismic Hazard Values

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 44.336N 78.316W

User File Reference: 100 Marina Blvd, Peterborough, ON.

2021-11-05 15:59 UT

Requested by: Cambium Inc.

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.105	0.065	0.042	0.014
Sa (0.1)	0.141	0.090	0.060	0.022
Sa (0.2)	0.134	0.088	0.061	0.023
Sa (0.3)	0.112	0.076	0.052	0.020
Sa (0.5)	0.091	0.062	0.043	0.016
Sa (1.0)	0.055	0.036	0.025	0.008
Sa (2.0)	0.028	0.018	0.012	0.003
Sa (5.0)	0.007	0.004	0.003	0.001
Sa (10.0)	0.003	0.002	0.001	0.001
PGA (g)	0.080	0.051	0.034	0.012
PGV (m/s)	0.077	0.048	0.031	0.010

Notes: Spectral ($S_a(T)$, where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s . Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information