SPECIFICATIONS

REQUEST FOR TENDER NO. T23022

FIRE STATION NO. 2 RENOVATIONS

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1 General

1.1 GENERAL CONDITIONS

.1 The General Conditions of the Stipulated Price Contract, Standard Construction Document, CCDC 2 - 2008, will govern the work specified in each Section of the Specifications.

1.2 DESCRIPTION OF WORK

.1 Work of this Contract comprises of selective demolition and renovation to existing Ajax Fire Hall as outlined in the Contract Documents, including work in Specification and Drawings by Elexicon Energy for the new transformers, metering cabinet, grounding, and protective bollards, and other related components. Contractor to obtain these Drawings and Specifications from Elexicon Energy.

.2 Division of the Work among Sub-Contractor's, Suppliers or Vendors is solely the Contractors responsibility. Neither the Owner nor Consultant assumes any responsibility to act as an arbiter to establish subcontract terms between sectors or disciplines of work.

1.3 THE CONTRACT DOCUMENTS

.1 Work will be performed under one Contract; the Contract will be in the form of the Agreement between Owner and Contractor, Canadian Standard Construction Document, CCDC 2 – 2008, Stipulated Price Contract as amended by the Supplementary Conditions.

.2 Division 1 General Requirements, of the Specification generally specify work and coordination of the work that is the direct responsibility of the Contractor but shall not be interpreted to define absolutely the limits of responsibility that must be established between the Contractor and his Sub-Contractors by their separate agreements.

.3 Ensure that Sub-Contractors understand that the General Conditions of the Contract, and Division 1 General Requirements, apply to Sections of the Specification governing their work.

.4 Ensure that the work includes all labour, equipment, fuel and products required, necessary or normally recognized as necessary for the proper and complete execution of the work of each trade.

.5 Work in this Specification is divided into descriptive Sections which are not intended to identify absolute contractual limits between Sub-Contractor, nor between the General Contractor and his Sub-Contractors. The Contractor shall organize division of labour and supply of materials essential to complete the Project in all its parts and provide a total enclosure and protection from weather of interior spaces, as established in the General Conditions of the Contract.

.6 As a result, the Consultant shall not be required to decide on questions arising with regard to agreements or contracts between the Contractor and Sub-Contractors or Suppliers, nor to the extent of the parts of the Work assigned thereto.

.7 Further, no extra will be allowed as a result of the failure to coordinate and allocate the Work such that the Work is Provided in accordance with the Contract Documents.

.8 Wherever the word "building" occurs in the Contract Documents it shall be taken to mean all the buildings included in the Contract.

.9 Wherever in the Contract Documents the words "approval", "approved", "direction", "directed", "selection", "selected", "request", "requested", "report", and similar words are used, such approvals, directions, selections, requests and reports shall be given by the Consultant in writing unless specifically stated otherwise.

.10 Wherever in the Contract Documents the word "supply" is used in any form, it shall mean that the work specified to be supplied includes delivery to site and unloading at location directed.

.11 Wherever in the Contract Documents the word "installed" issued in any form, it shall mean that the work specified for installation includes uncrating, unpacking, etc.; moving from stored location to place of installation; and installing to meet specified requirements.

.12 Wherever in this Specification it is specified that work is to proceed or to meet approval, direction, selection or request of authorities having jurisdiction or others, such approval, direction, selection or request shall be in writing.

.13 Wherever in this Specification or as directed by the Consultant it is specified that work shall be repaired, made good or replaced, it shall be performed without any additional cost to the Owner.

.14 Whenever in the Specifications the term "and/or" is used, the Consultant shall decide which of the possible meanings, to be derived at from the sentence where this term occurs shall govern.

1.4 DIVISION 01 – GENERAL REQUIREMENTS

.1 The provisions of all Sections of Division 01 shall apply to each Section of this Specification.

1.5 STANDARDS AND CODES

.1 Contract forms, codes, specifications, standards, manuals and installation, application and maintenance instructions referred to in these specifications, unless otherwise specified, amended or date suffixed, shall be latest published editions at Contract date.

1.6 LAWS, NOTICES, PERMITS AND FEES

.1 Comply with codes, by-laws, and regulations of authorities having jurisdiction over the Place of the Work. Codes and regulations form an integral part of the Contract Documents.

.2 Permits:

.1 The Contractor shall obtain and pay for all permits, licenses, deposits and certificates of inspection as part of the Work, including permits for road closures.

.2 Complete application process of permit application process initiated by the Owner, including all associated costs and responsibilities.

.3 Obtain permits required to execute work on municipal rights of way. Obtain damage deposits for sidewalks, roads and services, unless otherwise indicated.

.3 Arrange for inspection, testing and acceptance of the Work required by the authorities having jurisdiction. Be responsible for necessary preparations, provisions and pay costs.

.4 It is the responsibility of the Contractor to schedule notifications and inspections required by authorities having jurisdiction such that notifications can be properly received and that inspections can be properly undertaken without causing a delay in the Work. The Contractor, at no additional cost to the Owner, shall be solely responsible for any delay in the Work caused by failure to properly schedule required notifications and inspections.

1.7 DISCREPANCIES AND CLARIFICATIONS

.1 Advise Consultant of discrepancies discovered in requirements of the Contract Documents and request clarification from Consultant in written form.

.2 Advise Consultant when clarifications are required pertaining to meaning or intent of requirements of Contract Documents and request clarification from Consultant in written form.

.3 Do not proceed with related work until written clarification is provided by Consultant.

.4 Failure to notify Consultant shall result in Contractor incurring responsibility for resulting deficiencies and expense at no additional cost to the Owner.

.5 Written instructions issued by Consultant for the purpose of clarification, implicitly supersede applicable and relevant aspects of the Contract Documents irrespective of whether or not these documents are explicitly or specifically cited in clarification requests or clarification instructions.

1.8 WORK BY OWNER

.1 Permit the Owner and/or their Contractors to inspect the work at any reasonable time, and to perform such work and install such equipment as the Owner may require.

1.9 ITEMS SUPPLIED BY OWNER

.1 Certain items may be supplied by the Owner for installation in, and as part of, the Work.

.2 Install items supplied by Owner during the Work as specified.

.3 Coordinate shipping with the Owner. Items supplied by the Owner will be made available from the Owner’s storage facility located in proximity to the Place of the Work: Contractor to arrange and pay cost of pick-up and shipping to the Place of the Work. Location of Owner’s storage facility may change through the course of the Work to another nearby facility.

.4 Store items supplied by Owner at the Place of the Work and protect from damage in the same manner as items supplied by the Contractor.

.5 Install completely, and leave in full operating condition, in accordance with manufacturer's directions.

.6 Make use of items supplied by Owner and obtain approval from Owner before fabricating new stock.

1.10 CONSTRUCTION PROGRESS SCHEDULE

.1 Meet with Owner and Consultant within 5 working days of Contract award, to discuss proposed approach for undertaking the Work, inclusive of methodology, sequencing, Construction Equipment, and labour resources to be utilized.

.2 Submit a preliminary as-planned schedule as indicated in Section 01 32 16 within 15 working days after Contract award.

.3 Once preliminary as-planned schedule is approved and the final as-planned schedule is created, record "progress to date" on a copy of schedule to be available at the Site. Inspect Work with the Owner and the Consultant at least bi-weekly to establish progress on each current activity.

.4 The Contractor's schedule is to be updated and resubmitted to the Consultant as a progress schedule at least once per month, on a date to be mutually agreed by the Contractor and the Consultant.

1.11 SITE PROGRESS RECORDS

.1 Maintain at site a permanent written record of progress of work. Make the record available at all times with copies provided when requested. Include in record each day:

- .1 Weather conditions with maximum and minimum temperatures.
- .2 Conditions encountered during excavation. Record quantities pumped for dewatering.
- .3 Commencement and completion dates of the work of each trade in each area of Project.
- .4 Erection and removal dates of formwork in each area of Project.
- .5 Dates, quantities, and particulars of each concrete pour.
- .6 Dates, quantities, and particulars of waterproofing installation.
- .7 Attendance of Contractor's and Sub-Contractor's work forces at Project and a record of the work they perform.
- .8 Dates, status and particulars of submissions, i.e., shop drawings, samples, mock-ups and the like.
- .9 Dates, status and particulars of deliveries, i.e., manufacturing dates, delivery and installation dates.
- .10 Visits to site by Owner, Consultant, authorities having jurisdiction, testing companies, Contractor, Sub-Contractors, and Suppliers.

.2 Maintain a progress chart in approved format. Show on chart proposed work schedule and progress of work by Contractor and Sub-Contractor. The status of delivery items, i.e., shop drawings status, manufacture dates - delivery and installation dates.

1.12 DOCUMENTS AT THE PLACE OF THE WORK

.1 Maintain at the Place of the Work, one copy of each of following:
- .1 Contract Documents including drawings, specifications, addenda, and other modifications to the Contract, including copies of standards and codes referenced in the Contract Documents.
- .2 'Reviewed' or 'Reviewed as Modified' shop drawings. Refer to Section 01 33 00 for details of schedules required.
- .3 Construction, inspection and testing, and submittal schedules.
- .4 Supplemental Instructions, proposed Change Orders, Change Orders, and Change Directives.
- .5 Field Test Reports.
- .6 Consultant's field review reports and deficiency reports.
- .7 Reports by authorities having jurisdiction.
- .8 Building and other applicable permits, and related permit documents.
- .9 Daily log of the Work.
- .10 As-built drawings recording as-built conditions, instructions, changes, and the like, as called for in Section 01 33 00, prior to being concealed.

.2 Make above material available to Consultant upon request.

1.13 TRADEMARK AND LABELS

.1 Trademarks and labels, including applied labels, shall not be visible in finished work in finished areas, unless otherwise accepted or indicated by Consultant.

1.14 EXAMINATION

.1 Examine site and ensure that each Sub-Contractors performing work related to site conditions has examined it, so that all are fully informed on all particulars which affect the Project Work (thereon and at the place of the building, and in order that construction proceeds competently and expeditiously).

.2 Ensure by examination that all physical features at the work, and working restrictions and limitations which exist are known, so that the Owner is not restricted in use of the premises.

.3 Previously Completed Work:
- .1 Where dimensions are required for proper fabrication, verify dimensions of completed work in place before fabrication and installation of work to be incorporated with it.
- .2 Verify that previously executed work and surfaces are satisfactory for installation or application, or both, and that performance of subsequent work will not be adversely affected.
- .3 Ensure that work installed in an unsatisfactory manner is rectified by those responsible for its installation before further work proceeds.
- .4 Commencement of work will constitute acceptance of site conditions and previously executed work as satisfactory.
- .5 Defective work resulting from application to, or installation on, or incorporation with, unsatisfactory previous work will be considered the responsibility of those performing the later work.

.4 Construction Measurements:
- .1 Take site dimensions of completed work before installation of work to be incorporated commences.
- .2 Before commencing installation of work, verify that its layout is accurately in accordance with intent of Drawings, and that positions, levels, and clearances to adjacent work are maintained.
- .3 Before commencing work, verify that all clearances required by authorities having jurisdiction can be maintained.
- .4 If work is installed in wrong location, rectify it before construction continues.
- .5 Where dimensions are not available before fabrication commences, the dimensions required shall be agreed upon between the trades concerned.
- .6 All measurements shall be metric.

1.15 PROTECTION OF WORK, PROPERTY AND PERSONS

.1 Include in work necessary methods, materials, and construction to ensure that no damage or harm to work, materials, property and persons results from the work of this Contract. Temporary facilities relating to protection are specified in Section 01 50 00.

.2 Comply with all instructions and/or orders issued by authorities having jurisdiction.

.3 Ensure that compulsory wearing of hard hats and safety boots is observed by all persons employed on the work. Provide spare hard hats for visitors, refuse admission to the premises to those refusing to wear same.

.4 Keep excavations, and pits free of rainwater, ground water, backing up of drains and sewers, and all other water. Pump dry as required.

.5 Protect adjacent private and public property from damage and, if damaged, make good immediately. Make good private property to match in all details its original condition in material and finishes as approved, and public property in accordance with requirements specified and/or instructed by its Owner or as directed by the Consultant.

.6 Keep surfaces, on which finish materials will be applied, free from grease, oil, and other contamination which would be detrimental in any way to the application of finish materials.

.7 Do not apply visible markings to surfaces exposed to view in finished state or that receive transparent finishes.

.8 Protect surfaces of completed work exposed to view from staining, disfigurement and all other damage by restriction of access or by use of physical means suitable to the material and surface location. Establish with each Sub-Contractor the suitability of such protection in each case.

.9 Brace and shore masonry walls until their designed lateral support is incorporated at both top and bottom, in accordance with safe construction practices.

.10 Enforce fire prevention methods at site for new work maintain existing in accordance with local authorities having jurisdiction. Do not permit bonfires,

open flame heating devices or accumulation of debris. Use flammable materials only if proper safety precautions are taken, both in use and storage.

.11 Do not store flammable materials in the building. Take necessary measures to prevent spontaneous combustion. Place cloths and other disposable materials that are a fire hazard in closed metal containers and remove them from the building every night.

.12 Where flammable materials are being applied, ensure that adequate ventilation is provided, spark-proof equipment is used, and smoking and open flames are prohibited.

.13 Ensure that volatile fluid wastes are not disposed of in storm or sanitary sewers or in open drain courses.

.14 Perform spill response in accordance with procedures outlined by authority having jurisdiction, and upon request by Owner, provide detailed spill response procedures report for review.

.15 Public Utilities and Services:

.1 Verify location of and limitations imposed by, existing mechanical, electrical, telephone and similar services, and protect them from damage. If necessary, relocate active services to ensure that they function continuously wherever possible in safety and without risk of damage or down time to the existing buildings.

.2 Cap off and remove unused utility services encountered during work after approval is given by the utilities concerned or authorities having jurisdiction, which ever may apply. Relocation, removal, protection and capping of existing utility services shall be performed only by the applicable utility, and of other services by licensed mechanics.

.3 Make arrangements and pay for connection charges for services required for the Work.

.16 Ensure that precautions are taken to prevent leakage and spillage from plumbing and mechanical work that may damage surfaces and materials finished or unfinished.

.17 Give constant close supervision to roofing/waterproofing membranes following their installation, during the time they are temporarily protected or exposed, to ensure that no damage occurs to them before completion of building.

.18 Prevent spread of dust beyond the construction site by wetting, or by other approved means, as required or as directed by the Consultant and/or authorities having jurisdiction.

.19 Make good roads, soft landscaping, walkways, curbs, sidewalks, possessions and property, soiled or damaged due to the Work, to requirements of authorities having jurisdiction and requirements of and Making Good, as applicable.

1.16 WORK ON PUBLIC PROPERTY

.1 Include curb cuts and making good of existing property to provide fully paved and finished approaches to requirements of authorities having jurisdiction.

.2 Include making good of existing curbs, walks, paving and soft landscaping on adjacent property.

1.17 INSERTS, ANCHORS AND FASTENINGS

.1 Include in the work of each Section necessary fastenings, anchors, inserts, attachment accessories, and adhesives. Where installation of devices is in work of other Sections, deliver devices in ample time for installation, locate devices for other Sections and co-operate with other Sections as they require.

.2 Do not install wood plugs or blocking for fastenings in masonry, concrete, or metal construction, unless specified or indicated on the Drawings.

.3 Do not use fastenings which cause spalling or cracking of materials in which they are installed. Do not use powder actuated fastening devices unless specified or prior written approval is given by the Consultant for each specific use.

.4 Use only approved driven fasteners.

.5 Install metal-to-metal fastenings fabricated of the same metal or of a metal which will not set up electrolytic action causing damage to fastenings or components, or both. Use non-corrosive or galvanized steel fastenings for exterior work, and where attached to, or contained within, exterior walls and slabs. Leave steel anchors bare where cast in concrete.

.6 Install work with fastenings or adhesives in sufficient quantity to ensure permanent secure anchorage of materials, components, and equipment. Space anchors within limits of load-bearing or shear capacity.

.7 Space exposed fastenings evenly and in an organized pattern. Keep number to a minimum. Provide exposed metal fastenings of same material, texture, colour and finish as metal on which they occur.

.8 At fastenings that penetrate metal roof deck, ensure that penetrations are sealed airtight with approved sealant.

.9 Galvanize steel anchors in masonry and at exterior of building, unless otherwise specified elsewhere. Leave steel anchors bare where cast in concrete.

1.18 CLEANING

.1 Ensure that spatters, droppings, soil, labels, and debris are removed from surfaces to receive finishes, before they set up. Leave work and adjacent finished work in new condition.

.2 Use only cleaning materials which are recommended for the intended purpose by both the manufacturer of the surface to be cleaned and by the cleaning material supplier.

.3 Maintain areas "broom clean" at all times during the work. Vacuum clean interior areas immediately before finish painting commences.

.4 Do not burn or bury waste material at site. Remove as often as required to avoid accumulation.

.5 Do not allow waste material and debris to accumulate in an unsightly or hazardous manner. Sprinkle dusty accumulations with water or other approved materials during removal of same.

.6 Control lowering of materials. Use as few handlings as possible. Do not drop or throw materials from storeys above grade.

.7 Ensure that cleaning operations are scheduled to avoid deposit of dust or other foreign matter or surfaces during finishing work and until wet or tacky surfaces are cured.

.8 Each Section shall supply the Contractor with instructions for final cleaning of his work, and for inclusion in Project Data Book as specified in each trade Section and in Section 01 33 00.

.9 Final cleaning is to be performed 1 week prior to opening the project to the public and shall include cleaning of all work as required by each trade. Co-ordinate final cleaning with Owner's maintenance staff.

1.19 ADJUSTING

.1 Ensure that all parts of work fit snugly, accurately and in true planes, and that moving parts operate positively and freely, without binding and scraping.

.2 Verify that work functions properly and adjust it accordingly to ensure satisfactory operation.

.3 Lubricate products as recommended by the supplier.

1.20 SALVAGE

.1 Unless otherwise specified, surplus material resulting from construction, and construction debris shall become the property of Contractor, who shall dispose of it away from site.

.2 Treasure, such as coins, bills, papers of value, and articles of antiquity, discovered during digging, demolition and cutting at the site shall remain property of Owner, and shall be delivered immediately into his custody.

1.21 SIGNAGE

.1 All site signage prior to fabrication or installation shall have written approval by the Owner.

.2 The Contractor shall submit to the owner a layout of all required signage, show types, sizes and locations.

2 Products - Not Used

3 Execution - Not Used

END OF SECTION

WORK RESTRICTIONS

1 General

1.1 OWNER ACCESS

.1 The building and parking areas, which are not immediately affected by the Work, will remain occupied by the Owner during the Work. Owner will designate parking and staging areas for Contractor.

.2 Ensure adequate access to areas not occupied for the Work.

.3 Maintain access to the Monarch Driveway at all times during construction.

1.2 EXISTING SERVICES

.1 Notify Owner and utility companies of intended interruption of services and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services, give Owner a minimum of 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum.

.3 Construct barriers in accordance with Section 01 56 00.

1.3 SPECIAL REQUIREMENTS

.1 Restrictions for work involving major noise emitting activities shall be in accordance with the requirements of authorities having jurisdiction and Town of Ajax Noise By-law Number 38-2017.

.1 Major noise emitting activities include activities that generate sound or vibration that is of such levels, volume, or nature that is unusual and likely to disturb the inhabitants of the Town.

.2 Notify Owners and representatives of occupied buildings adjacent to the Place of the Work, as well as the Consultant and the Owner, a minimum of 48 hours prior to undertaking major noise emitting activities, including a description of the nature and extent of such activities.

1.4 WORKING HOURS

.1 Perform construction work on the days of the week and hours as permitted in Town of Ajax Noise By-law Number 38-2017.

.2 Submit planned working hours and schedule to the Owner for review at minimum 14 days prior to start of work. Prepare construction schedule in accordance with Section 01 32 16.

.3 Owner will not be responsible for additional costs associated with working after regular hours unless such after-hours work is ordered by the Owner and not specified as a requirement in the Contract Documents.

.4 Owner will not be responsible for additional costs associated with working after regular hours if such after-hours work is required for the Contractor to return to the agreed upon construction schedule.

1.5 COVID-19 PROTOCOL

.1 Ensure all Government and Owner-specific COVID-19 procedures are followed for the duration of the Contract. Monitor the latest recommendations from public health officials, adjust work procedures and provide personal protective equipment in accordance with those recommendations.

2 Products - Not Used

3 Execution - Not Used

END OF SECTION

ALLOWANCES

1 General

1.1 REFERENCES

.1 Canadian Construction Documents Committee CCDC 2-2008, Stipulated Price Contract including the Supplementary Conditions.

1.2 CASH ALLOWANCE

.1 Refer to General Conditions, GC4.1.

.2 Unless otherwise specified, Cash Allowances shall cover the cost of the materials and equipment delivered F.O.B. job site, and all applicable taxes, except Harmonized Sales Tax. The Contractor's handling costs on the site, labour, installation costs, overhead and profit and other expenses shall be included separately in the Stipulated Price and not in the Cash Allowance.

.3 Where it is specified that a Cash Allowances is to include both supply and installation costs, such allowances shall cover the cost of the materials and equipment delivered and unloaded at the site, all applicable taxes and the Contractor’s handling costs on the site, labour and installation costs and other expenses, except overhead and profit which shall be included separately in the Stipulated Price.

.4 If the cost of the Work covered by Cash Allowances, when determined, is more or less than the allowance, the Contract Sum shall be adjusted accordingly.

.5 In the event that the cost of the work covered by Cash Allowances should exceed the Cash Allowance, while the Contract Sum will be adjusted in conformity therewith, there shall be no adjustment to the Contractor's fee or other expenses such as overhead or profit, it being understood and agreed that the Contract Sum includes the Contractor's expenses and profit for all Cash Allowances whether or not they are exceeded.

.6 Progress payments on accounts of work authorized under Cash Allowances shall be included in monthly certificate for payment.

.7 Expenditures from Cash Allowances shall be authorized by Supplementary Instruction.

.8 Cash Allowance for independent inspection and testing shall cover the cost of such services as provided by independent testing agency only. The Contractor's cost for labour, overhead and other expenses related to independent inspection and testing shall be included separately in the Stipulated Price and not in the Cash Allowance.

.9 Cause the work covered by Cash Allowances to be performed for such amounts and by such persons as the Consultant may select and direct or as required by the Project Drawings and Specifications.

.10 Refer to eBidding system for list of Cash Allowances.

2 Products - Not Used

3 Execution - Not Used

END OF SECTION

1 General

1.1 APPROVED ALTERNATES AND APPROVED EQUIVALENT

.1 Named Products alternates or equals, indicated by the phrases "or approved alternate by XYZ Manufacturing" or "or approved equal by XYZ Manufacturing", shall be interpreted to mean that named Product alternate or equal, if selected for use in lieu of indicated or specified Product, meets or exceeds performance, appearance, general arrangement, dimensions, availability, code and standards compliance, and colour of specified Product.

.2 Be responsible for costs and modifications associated with the inclusion of named Product alternate or equal at no additional cost to the Owner.

.3 The process for proposing and approving alternates or equals, including alternate design solutions, shall be the same process as for proposing and approving substitutions (refer to paragraph 1.2 below).

.4 Confirm delivery of specified items prior to proposing alternates or equals.

1.2 SUBSTITUTIONS

.1 Submission of substitutions:
- .1 Proposals for substitutions of Products and materials must be submitted in accordance with procedures specified in this Section.
- .2 Consultant may review submissions, if directed by Owner, but in any case, with the understanding that the Contract Time will not be altered due to the time required by the Consultant to review the submission and by the Contractor to implement the substitution in the Work.

.2 Submission requirements:
- .1 Description of proposed substitution, including detailed comparative specification of proposed substitution with the specified Product.
- .2 Manufacturer’s Product data sheets for proposed Products.
- .3 Respective costs of items originally specified and the proposed substitution.
- .4 Confirmation of proposed substitution delivery, in writing by Product manufacturer.
- .5 Compliance with the building codes and requirements of authorities having jurisdiction.
- .6 Effect on compatibility and interface with adjacent building materials and components.
- .7 Compliance with the intent of the Contract Documents.
- .8 Effect on Contract Time.
- .9 Reasons for the request.

.3 Substitutions submitted on shop drawings without following requirements of this Section prior to submission of the affected shop drawings will cause the shop drawings to be rejected.

.4 Proposed substitutions shall include costs associated with modifications necessary to other adjacent and connecting portions of the Work.

.5 Consultant's decision concerning acceptance or rejection of proposed substitutions is final. Should it appear to the Consultant that the value of services required to evaluate the substitution exceeds the potential reduction, the Consultant will advise the Owner that the substitution does not merit consideration before proceeding with a full evaluation. If the substitution will produce a reduction commensurate with or exceeding the value of the Consultant's services to evaluate the substitution, the Consultant will request the Owner's direction to proceed with evaluation.

.6 There is no obligation on the part of the Consultant or Owner to accept proposed substitutions.

1.3 SUBSTITUTIONS - CODE REQUIREMENTS

.1 Ensure that proposed substitutions for materials, products, methods and processes meet the requirements of the building code, and authorities having jurisdiction.

.2 Ensure that proposed substitute materials, products, methods and processes do not negate the compliance of adjacent materials, products and constructions with the requirements of the applicable building code and other requirements of authorities having jurisdiction, to which the proposed substitutions may be applied or attached.

.3 Obtain written approval of proposed substitutions from the authority having jurisdiction and submit the approval with the proposed substitution for the Consultant's consideration.

2 Products - Not Used

3 Execution - Not Used

END OF SECTION

1 General

1.1 REQUEST FOR INTERPRETATION - RFI

.1 A request for interpretation (RFI) is a formal process used during the Work to obtain an interpretation of the Contract Documents.

.2 Submittal procedures:

.1 RFI form:

.1 Submit RFI on “Request for Interpretation” form, appended to this Section. The Consultant shall not respond to an RFI except as submitted on this form.

.2 Where RFI form does not provide sufficient space for complete information to be provided thereon, attach additional sheets as required.

.3 Submit with RFI form necessary supporting documentation.

.2 RFI log:

.1 Maintain log of RFIs sent to and responses received from the Consultant, complete with corresponding dates.

.2 Submit updated log of RFIs with each progress draw submittal.

.3 Submit RFIs sufficiently in advance of affected parts of the Work so as not to cause delay in the performance of the Work. Costs resulting from failure to do this will not be paid by the Owner.

.4 RFIs shall be submitted only to the Consultant.

.5 RFIs shall be submitted only by Contractor. RFIs submitted by Sub-Contractors or Suppliers shall not be accepted.

.6 Number RFIs consecutively in one sequence in order submitted.

.7 Submit one distinct RFI per RFI form.

.8 Consultant shall review RFIs from the Contractor submitted in accordance with this Section, with the following understandings:

.1 Consultant’s response shall not be considered as a Change Order or Change Directive, nor does it authorize changes in the Contract Price or Contract Time or changes in the Work.

.2 Only the Consultant shall respond to RFIs. Responses to RFIs received from entities other than the Consultant shall not be considered.

.9 Allow 10 Working Days for review of each RFI by the Consultant.

.1 Consultant’s review of RFI commences on date of receipt by the Consultant of RFI submittal and extends to date RFI returned by Consultant.

.2 When the RFI submittal is received by Consultant before noon, review period commences that day; when RFI submittal is received by Consultant after noon, review period begins on the next Working Day.

.10 Contractor shall satisfy itself that an RFI is warranted by undertaking a thorough review of the Contract Documents to determine that the claim, dispute, or other matters in question relating to the performance of the Work or the interpretation of the Contract Documents cannot be resolved by direct reference to the Contract Documents. Contractor shall describe in detail this review on the RFI form as part of the RFI submission. RFI submittals that lack such detailed review description, or where the detail provided is, in the opinion of the Consultant, insufficient, shall not be reviewed by the Consultant and shall be rejected.

REQUESTS FOR INTERPRETATION

Contractor's Requests for Interpretation
Contractor's Supplemental Instructions

Date	**No. of Pages**
To	**From**
Co.	**Co.**
Phone #	**Phone #**
Fax #	**Fax #**

Project: _____ **RFI No.:** _____

Owner: _____ **Date of Request:** _____

To: _____ **Contractor:** _____

(Consultant's Representative)

Project No.: _____ **Contractor's Representative:** _____

Consultant's Fax No.: _____ **Fax No.:** _____

Interpretation Requested: (Description of request for interpretation and references to relevant portions of Contract Documents)

Attachements: _____

Requested by: _____

Consultant's Supplemental Instruction:

Attachements: _____

Reply by: _____

The work shall be carried out in accordance with these Supplemental Instructions issued in accordance with the Contract Documents without change in Contract Price or Contract Time. Prior to proceeding with these instructions, indicate accemptance of these instructions as being consistent with the Contract Documents by returning a signed copy to the Consultant.

Supplemental Instruction Issued:

By: _____
Consultant **Date**

Supplemental Instruction Accepted:

By: _____
Contractor **Date**

Cc: ☐ **Owner** ☐ **Consultant** ☐ **Contractor** ☐ **Field** ☐ **Other:** _____

1 General

1.1 DESCRIPTION

.1 Coordination of the work of all Sections of the Specification is the responsibility of the Contractor.

.2 The Contractor will be deemed to possess the necessary technical skills to carefully evaluate all requirements of the Contract, and to have included in the Price all costs for the proper implementation of these requirements.

.3 The Contractor's responsibility includes, but is not restricted to, co-ordination specified in this Section, except where otherwise specified.

1.2 RELATED MECHANICAL AND ELECTRICAL WORK

.1 Coordination of the installation of systems specified in Divisions 20 to 33, including the interrelating operation and functioning between components of a system and between systems, is the responsibility of those performing the work of Divisions 20 to 33, with final coordination the responsibility of the Contractor.

.2 Provide interference Drawings as herein specified to ensure proper co-ordination of subtrade work. No extras will be considered for work not properly coordinated prior to installation.

.3 Ensure that service poles, pipes, conduit, wires, fill-pipes, vents, regulators, meters and similar Project service work is located in inconspicuous locations. If not indicated on Drawings, verify location of service work with Consultant before commencing installation.

1.3 QUALITY ASSURANCE

.1 Requirements of Regulatory Agencies:
  .1 Coordinate requirements of authorities having jurisdiction.

.2 Quality Control:
  .1 Ensure that work meets specified requirements.
  .2 Schedule, supervise and coordinate inspection and testing as specified in Section 01 40 00.

.3 Job Records:
  .1 Maintain job records and ensure that such records are maintained by Sub-Contractors.

1.4 SUPERINTENDENCE

.1 Provide superintendent and necessary supporting staff personnel who shall be in attendance at the Place of the Work while Work is being performed, with proven experience in erecting, supervising, testing and adjusting projects of comparable nature and complexity.

.2 The Contractor shall appoint a Superintendent at the Place of the Work who shall have overall authority at the Place of the Work and shall speak for the Contractor and represent the Contractor’s interest and responsibilities at meetings at the Place of the Work and in dealings with the Consultant and the Owner.

.3 Supervise, direct, manage and control the work of all forces carrying out the Work, including Sub-Contractors and Suppliers. Carry out daily inspections to ensure compliance with the Contract Documents and the maintenance of quality standards. Ensure that the supervisory staff includes personnel competent in supervising all Sections of Work required.

.4 Arrange for sufficient number of qualified assistants to the Supervisor as required for the proper and efficient execution of the Work.

1.5 SUBMITTALS

.1 Provide a complete set of all required Contract Documents, together with instructions for changes to the work which are issued, to each firm preparing shop drawings.

.2 Schedule and expedite submission of specified submittals.

.3 Review submittals and make comments as specified in Section 01 33 00.

.4 Ensure that each original submission, and their subsequent revisions and resubmissions are made on schedule.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 It is the responsibility of the Contractor to ensure that the Supplier or distributor of materials specified or accepted alternatives, which have been bid, has materials on the site when required. The Contractor shall obtain confirmed delivery dates from the Supplier and ensure no delay in the progress of the Work.

.2 Provide equipment delivery schedule, coordinated with construction and submittals schedule, showing delivery dates for major and/or critical equipment. Provide delivery access and unloading areas.

.3 Make available areas for storage of Products and construction equipment to meet specified requirements, and to ensure a minimum of interference with progress of the Work and relocation.

.4 Make access available for transference of stored Products and construction equipment to work areas.

.5 The Contractor shall contact the Consultant immediately upon receipt of information indicating that any material or item, will not be available on time, in accordance with the original schedule, and similarly it shall be the responsibility of all Sub-Contractors and Suppliers to so inform the Contractor.

.6 The Consultant reserves the right to receive from the Contractor at any time, upon request, copies of actual purchase or work orders of any material or Products to be supplied for the Work.

.7 If materials and Products have not been placed on order, the Consultant may instruct such items to be placed on order, if direct communication in writing from the manufacturer or prime Suppliers is not available indicating that delivery of said material will be made in sufficient time for the orderly completion of the Work.

.8 The Consultant's review of purchase orders or other related documentation shall in no way release the Contractor, or his Sub-Contractors and Suppliers from their

responsibility for ensuring the timely ordering of all materials and items required, including the necessary expediting, to complete the work as scheduled in accordance with the Contract Documents.

1.7 JOB CONDITIONS

.1 Ensure that conditions within the building are maintained and that work proceeds under conditions meeting specified environmental requirements.

.2 Ensure that protection of adjacent property and the work is adequately provided and maintained to meet specified requirements.

1.8 WARRANTIES

.1 Ensure that warranties are provided, as indicated in Section 01 78 36.

.2 Coordinate warranty conditions of interconnected work to ensure that full coverage is obtained.

1.9 CO-ORDINATION

.1 Review Contract Documents and advise the Consultant of possible conflicts between parts of the work before preparation of shop drawings, ordering of Products or commencement of affected work.

.2 Coordinate and be responsible for layout of all work in each area and work on which subsequent work depends to facilitate mutual progress, and to prevent conflict between parts of the work.

.3 No addition to the Total Price will be allowed because of interference between the parts of the work of a trade or between the work of different trades unless such interference was brought to the attention of the consultant in writing prior to the start of construction.

.4 Ensure that each Section makes known, for the information of the Contractor and other Sections, the environmental and surface conditions required for the execution of its work; and that each Section makes known the sequences of others' work required for installation of its work.

.5 Ensure that each Section, before commencing work, knows requirements for subsequent work and that each Section is assisted in the execution of its preparatory work by Sections whose work depends upon it.

.6 Ensure that work to be enclosed within ceiling and/or wall spaces can be accommodated without interference and with other parts of the work.

.7 Ensure that setting drawings, templates, and all other information necessary for the location and installation of materials, holes, sleeves, inserts, anchors, accessories, fastenings, connections, and access panels are provided by each Section whose work requires cooperative location and installation by other Sections, and that such information is communicated to the applicable Installer.

.8 Deliver materials supplied by one Section to be installed by another well before the installation begins, as per Construction Progress Schedule.

.9 Sections giving installation information in error, or too late to incorporate in the work, shall be responsible for having additional work done which is thereby made necessary.

.10 Remove and replace work installed in error which is unsatisfactory for subsequent work.

.11 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the spaces provided.

.12 Prepare drawings to indicate coordination and methods of installation of a system with other systems where their relationship is critical. Ensure that all details of equipment apparatus, and connections are coordinated.

.13 Ensure that clearance required by authorities having jurisdiction and for proper maintenance are indicated on Drawings.

.14 Distribute coordination drawings well in advance of fabrication and installation of work affected. Place no orders for affected equipment without submission of coordination drawings to the Supplier.

1.10 COOPERATION

.1 Provide forms, templates, anchors, sleeves, inserts and accessories required to be fixed to or inserted in the Work and set in place or instruct separate Sub-Contractors as to their locations.

.2 Supply items to be built in, as and when required together with templates, measurements, shop drawings and other related information and assistance.

.3 Pay the cost of extra work and make up time lost as a result of failure to provide necessary information and items to be built in.

1.11 PROJECT RECORD DRAWINGS

.1 Record, as the work progresses, work constructed differently than shown on Contract Documents. Record all changes in the work caused by site conditions; by Owner, Consultant, Sub-Consultants, Contractor, and Sub-Contractor originated changes; and by site instructions, supplementary instructions, field orders, Change Orders, addendums, correspondence, and directions of authorities having jurisdiction. Accurately record location of concealed structure, and mechanical and electrical services, piping, valves, conduits, pull boxes, junction boxes and similar work not clearly in view, the position of which is required for maintenance, alteration work, and future additions. Do not conceal critical work until its location has been recorded.

.2 Dimension location of concealed work in reference to building walls, and elevation in reference to floor elevation. Indicate at which point dimension is taken to concealed work. Dimension all terminations and offsets of runs of concealed work.

.3 Make records in a neat and legibly printed manner with a non-smudging medium.

.4 Identify each record drawing as "Project Record Copy". Maintain drawings in good condition and do not use them for construction purposes.

.5 After completion of the work, purchase a complete set of white prints from the Consultant and transfer the information recorded on the white prints accurately, neatly in red ink with dimensions, as applicable. Return these marked-up as-built white prints plus two additional sets of white prints to the Consultant for his review. Any subsequent changes found by the Consultant shall remain the responsibility of the Contractor and new white prints will be issued for these changes and re-submitted back to the Consultant at no charge to the Owner.

.6 Maintain Project record drawings in a state current to Project. Such state will be considered a condition precedent for validation of applications for payment. The Consultant's visual inspection will constitute proof that record drawings are current.

.7 Provide Consultant with accurate, red-marked record drawings for their transfer to latest version of AutoCad with application for Certificate of Substantial Performance. Final acceptance of the Work will be predicated on receipt and approval of record drawings.

1.12 CUTTING AND PATCHING

.1 Before cutting, drilling, or sleeving structural load-bearing elements, obtain approval of location and methods from the Consultant.

.2 Do not endanger work or property by cutting, digging, or similar activities. No Section shall cut or alter the work of another Section unless such cutting or alteration is approved by the latter Section and the General Contractor.

.3 Cut and drill with true smooth edges and to minimum suitable tolerances.

.4 Fit construction tightly to ducts, pipes and conduits to stop air movement completely. The Section performing work that penetrates a fire, air, vapour, moisture, thermal or acoustic separation of the building shall pack voids tightly with rock wool, fibreglass or fire stop material as may be required; seal air, vapour and moisture barriers; and caulk joints as may be required to ensure that no air movement through the penetration is possible.

.5 Cutting, drilling and sleeving of work shall be done only by the Section who has installed it. The Section requiring drilling and sleeving shall inform the Section performing the work of the location and other requirements for drilling and sleeving.

.6 Replace, and otherwise make good, all damaged work, as identified by the Consultant or Contractor.

.7 Cutting and Patching for Holes Required by Mechanical and Electrical work:

.1 Include under work of Divisions 20 to 33 cutting or provision of holes up to and including 50 square inches and related patching, except as otherwise indicated.

.2 Include under work of this Division holes and other openings larger than 50 square inches, and chases, bulkheads, furring and required patching. This Section shall be responsible for determination of work required for holes in excess of 50 square inches.

.8 This Section shall be responsible for all cutting and patching in addition to that specified for mechanical and electrical work and shall directly supervise performance of cutting and patching by other Sections.

.9 Patching or replacement of damaged work shall be done by the Sub-Contractor under whose work it was originally executed, and at the expense of the Sub-Contractor who caused the damage.

.10 Make patches as invisible as possible in final assembly to the approval of the Consultant/Owner. Unacceptable work will be replaced at no charge to the Owner.

2 Products - Not Used

3 Execution - Not Used

END OF SECTION

1 General

1.1 ADMINISTRATIVE

.1 Schedule and administer meetings every 2 weeks (or more frequently as required) with the Consultant throughout the progress of the Work. Schedules to be updated with the Consultant every 2 weeks for distribution at each meeting.

.2 Prepare agenda for such meetings.

.3 The Contractor shall chair such meetings. The Contractor shall administer such meetings and prepare minutes within 3 days after the meeting date for distribution to the Owner and the Consultant.

.4 Distribute written notice of each meeting 4 days in advance of meeting date to the Consultant and the Owner and other affected parties.

.5 Representatives of parties attending meetings shall be authorized to act on behalf of the parties they represent. Sub-Contractors and Suppliers do not attend meetings unless authorized by the Consultant and the Owner.

.6 Prepare and distribute monthly progress reports in accordance with Section 01 32 16, and containing updated schedules, construction photos in accordance with Section 01 33 00, shop drawing logs, requests for interpretation logs, submittals and budget.

1.2 CONTRACT START-UP MEETING

.1 Within 5 days after award of Contract, request a meeting of parties in Contract to discuss and resolve administrative procedures and responsibilities prior to the commencement of the Work.

.2 The Owner, the Consultant, the Contractor, Site Superintendent(s), inspection and testing company, and authorities having jurisdiction, as applicable and at their discretion, will be in attendance.

.3 Agenda to include the following:

- .1 Appointment of official representative of participants in the Project.
- .2 Status of permits, fees and requirement of authorities having jurisdiction. Action required.
- .3 Review of standard project forms.
- .4 Requirements for Contract modification and interpretation procedures, including, but not limited to: Requests for interpretation, proposed Change Orders, Change Orders, Change Directives, Supplemental Instructions, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
- .5 Requirements for notification for reviews. Allow a minimum of 2 Working Days notice to Consultant for review of the Work.
- .6 Review of working hours, schedules and scheduling procedures and requirements in accordance with Section 01 32 16.
- .7 Review of work restrictions and requirements, including parking and staging areas for Contractor. Refer to Section 01 14 00.
- .8 Appointment of inspection and testing agencies or firms, Section 01 40 00.

.9 Requirements for temporary facilities, signs, offices, storage sheds, utilities;
Section 01 50 00.
.10 Security requirements at and for the Place of the Work, Section 01 50 00.
.11 Record drawings, Section 01 33 00.
.12 Maintenance manuals, Section 01 33 00.
.13 Take-over procedures, acceptance, Section 01 77 19.
.14 Warranties, Section 01 78 36.
.15 Progress claims, administrative procedures, holdbacks.
.16 Insurances, transcripts of policies.
.17 Contractor's safety procedures.
.18 Cleaning/staging area for vehicles.
.19 Workplace Safety and Insurance Board Certificate.

.4 The Contractor shall organize and chair the Contract start-up meeting. Contractor will provide meeting agenda to Owner and Consultant 5 days prior to meeting for review. Contractor shall record minutes of the Contract start-up meeting and distribute a copy to each participant within 10 days of meeting.

1.3 PRE-INSTALLATION MEETINGS

.1 During the course of the Work prior to Substantial Performance of the Work, schedule pre-installation meetings as required by the Contract Documents and coordinated with the Consultant.

.2 As far as possible, pre-installation meetings shall be scheduled to take place on the same day as regularly scheduled progress meetings.

.3 Agenda to include the following:
.1 Appointment of official representatives of participants in the Project.
.2 Review of existing conditions and affected work and testing thereof as required.
.3 Review of installation procedures and requirements.
.4 Review of environmental and site condition requirements.
.5 Review of schedules and scheduling procedures and requirements of the applicable portions of the Work in accordance with Section 01 32 16, in particular:
.1 Schedule of submission of samples, mock-ups, and items for Consultant's consideration.
.2 Delivery schedule of specified equipment.
.3 Requirements for notification for reviews. Allow a minimum of 2 Working Days notice to Consultant for review of the Work.
.6 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences, Section 01 50 00.
.7 Requirements for inspections and tests, as applicable.
.1 Schedule and undertake inspections and tests in accordance with Section 01 32 16 and Section 01 40 00.
.8 Special safety requirements and procedures.

.4 The following shall be in attendance:
.1 Contractor.

.2 Sub-Contractors affected by the work for which the pre-installation meeting is being conducted.
.3 Consultant.
.4 Manufacturer's representatives, as applicable.
.5 Inspection and testing company, as applicable.

1.4 PROGRESS MEETINGS

.1 During the course of the Work prior to Substantial Performance of the Work, schedule progress meetings every 2 weeks.

.2 In advance of progress meetings, Contractor shall submit to the Consultant a 2 week look ahead schedule of items of work to be undertaken in the 2 weeks subsequent to the progress meeting. 2 week look ahead schedule will be reviewed at the meeting and recorded in the minutes of the meeting. Refer to Section 01 32 16 for requirements for look ahead schedule.

.3 Attendees at progress meetings shall include the following:
.1 Contractor.
.2 Contractor's Site Superintendent(s).
.3 Consultant.
.4 Owner.

.4 Agenda to include the following:
.1 Review, approval of proceedings of previous meeting.
.2 Review of items arising from proceedings.
.3 Review of progress of the Work since previous meetings.
.4 Review of schedules in accordance with Section 01 32 16, including:
.1 Revisions to construction schedule.
.2 Progress and schedule for subsequent period of the Work: 2 week look-ahead.
.3 Problems that impede compliance with construction schedule.
.4 Review of off-site fabrication delivery schedules.
.5 Review of material delivery dates/schedule.
.6 Corrective measures and procedures to regain construction schedule.
.7 Review of submittal schedules: Expedite as required.
.5 Field observations, problems, conflicts.
.6 Review status of submittals.
.7 Maintenance of quality standards.
.8 Pending changes and substitutions.
.9 Review of Contract modifications and interpretations including, but not limited to: Requests for interpretation and log, proposed Change Orders, Change Orders, Change Directives, Supplemental Instructions, for effect on construction schedule and on Contract Time.
.10 Review of status of as-built documents.
.11 Other business.

1.5 PRE-TAKEOVER MEETING

.1 Prior to application for Substantial Performance of the Work, schedule a pre-takeover meeting.

.2 Agenda to include the following:
- .1 Review, approval of proceedings of previous meeting.
- .2 Review of items arising from proceedings.
- .3 Review of procedures for Substantial Performance of the Work, completion of the Contract, and handover of the Work.
- .4 Field observations, problems, conflicts.
- .5 Review of outstanding Contract modifications and interpretations including, but not limited to: Requests for interpretation and log, proposed Change Orders, Change Orders, Change Directives, Supplemental Instructions, for effect on construction schedule and on Contract Time.
- .6 Problems which impede Substantial Performance of the Work.
- .7 Review of procedures for deficiency review. Corrective measures required.
- .8 Progress, schedule, during succeeding period of the Work.
- .9 Review submittal requirements for warranties, manuals, and all demonstrations and documentation required for Substantial Performance of the Work.
- .10 Review of status of as-built documents and record drawings.
- .11 Other business.

1.6 POST-CONSTRUCTION MEETING

.1 Prior to application for completion of Contract, schedule a post-construction meeting. 4 days prior to date for meeting, Consultant shall confirm a date for meeting based on evaluation of completion requirements.

.2 Agenda to include the following:
- .1 Review, approval of proceedings of previous meeting.
- .2 Confirmation that no business is arising from proceedings.
- .3 Confirmation of completion of the Contract, and handover of reviewed documentation from the Consultant to the Owner.
- .4 Confirmation of completion of proposed Change Orders, Change Orders, Change Directives, and Supplemental Instructions.
- .5 Problems that impede Contract completion.
- .6 Identify unresolved issues or potential warranty problems.
- .7 Confirmation of completion of deficiencies.
- .8 Corrective measures required.
- .9 Confirm submittal requirements for warranties, manuals, and demonstrations and documentation for Contract completion are in order.
- .10 Review of procedures for communication during post-construction period.
- .11 Handover of reviewed record documents by the Consultant to the Owner.
- .12 Handover of Contract completion insurance policy transcripts by Contractor.
- .13 Submission of final application for payment.
- .14 Review and finalize outstanding claims, pricing, and allowance amounts.
- .15 Status of commissioning and training.
- .16 Demobilization and the Place of the Work restoration.
- .17 Review of requests for interpretation log.

2 Products - Not Used

3 Execution - Not Used

END OF SECTION

1 General

1.1 LAYOUT AND SURVEY

.1 Lines, Levels and Locations for Building:

.1 Existing grades, lines, and site conditions shown on Drawings were taken from survey information established by persons engaged directly by Owner. The accuracy of survey information is not the Consultant's responsibility.

.2 The Owner will establish location of property lines. The Contractor shall establish necessary lines and levels and provide batter boards and other means to control the accurate positioning of all building elements.

.2 Work Adjacent to Public Property:

.1 Verify before commencing work at adjacent public property, that no plans for altering clearances, set-backs, easements, grades, or otherwise have been made by local authorities having jurisdiction, subsequent to their approval of Contract Documents, and which would affect the original intent.

1.2 SUBMITTALS

.1 Submit qualification data for land surveyor to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.

.2 Submit certificate signed by Land Surveyor certifying that location and elevation of improvements comply with requirements.

.3 Submit two copies of certified survey signed by registered Land Surveyor.

.4 Submit two copies of final property survey showing the Work performed and record survey data.

.5 Submit a Certificate of Compliance at completion of site grading stating the “As Constructed” grading elevations, and whether or not they differ from design grades.

1.3 DRAINAGE

.1 Ensure that positive drainage is provided to roof, floor and site drains and catch basins, as set in their final positions. Provide constant slopes for drained surfaces to drains and drainage courses.

.2 Ensure that allowable construction tolerances and structural tolerances do not permit ponding of water.

.3 Verify the extent of each area served by a drain, or drainage course, to eliminate possible undrained surfaces. Coordinate the work of involved Sections before each proceeds.

1.4 RECORD DRAWINGS

.1 Prepare interference and equipment placing drawings to scale to ensure that all components will be properly accommodated within the spaces provided.

.2 Ensure that clearances required by authorities having jurisdiction and/or for easy maintenance of equipment will be shown on the above drawings.

.3 Interference drawings shall be prepared before any orders for equipment and/or materials are released to Suppliers.

1.5 SURVEY REFERENCE POINTS AND LEGAL SURVEY MARKERS

.1 Verify existing base horizontal and vertical control points designated on Drawings.

.2 Locate, confirm and protect control points and legal survey markers prior to starting site work; preserve permanent reference points during construction.

.3 Make no changes or relocations without prior written notice to Consultant.

.4 Report to Consultant when a reference point or legal survey marker is lost or destroyed or requires relocation because of necessary changes in grades or locations.

.5 Replace control points in accordance with original survey control.

.6 Replace legal survey markers lost or destroyed as a result of construction activities.

1.6 SURVEY LAYOUT

.1 Coordinate with Contractor for layout and protection of grade controls.

.2 Establish permanent benchmark(s) as required, referred to established benchmarks by survey control points; record locations, with horizontal and vertical data.

.3 Establish lines and levels, locate and layout, by instrumentation.

.4 Stake for grading, cuts and fills, slopes.

.5 Replace grade controls lost or destroyed as a result of construction activities.

1.7 CONSTRUCTION LAYOUT

.1 Verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. Notify Consultant promptly if discrepancies are discovered.

.2 Engage a land surveyor to lay out the Work using accepted surveying practices:

- .1 Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
- .2 Establish dimensions within tolerances indicated; do not scale Drawings to obtain required dimensions.
- .3 Inform Installers of lines and levels to which they must comply.

.4 Check the location, level and plumb, of every major element as the Work progresses.
.5 Notify Consultant when deviations from required lines and levels exceed allowable tolerances.
.6 Verify accuracy of site dimensions shown on Drawings.
.7 Verify that present, or known future restrictions, are not violated by construction on the site or lines of traverse to all public utilities.
.8 Verify accurately the final underground location on site of all buried storm, sanitary, water and electrical duct banks, when applicable.
.9 Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

.3 Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

.4 Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Consultant when requested.

1.8 FIELD ENGINEERING

.1 Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations:
.1 Do not change or relocate existing benchmarks or control points without prior written approval of Consultant.
.2 Report lost or destroyed permanent benchmarks or control points promptly.
.3 Report the need to relocate permanent benchmarks or control points to Consultant before proceeding.
.4 Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
.5 Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
.6 Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
.7 Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

.2 Provide as-built site survey information after completion of demolition and excavation operations ready for construction.
.1 Survey grade elevations shall be on a 9m grid or as required to locate property lines and new building structural grid lines.

2 Products - Not Used

3 Execution - Not Used

END OF SECTION

1 General

1.1 PLANNING, SCHEDULING AND MONITORING - GENERAL

.1 This Section includes requirements for the preparation, monitoring and revision of construction schedules.

.2 The purpose of the schedules and reports mandated in this Section is to:
- .1 Ensure adequate planning and execution of the Work by the Contractor;
- .2 Establish the standard against which satisfactory completion of the project will be judged;
- .3 Assist the Owner and the Consultant in monitoring progress;
- .4 Assess the impact of changes to the Work.

.3 The Contractor has the obligation and responsibility at all times to plan and monitor all of its activities, anticipating and scheduling its staff, materials, plant and work methods in a manner that is likely to ensure completion of the Work in accordance with the terms and conditions of the Contract and at a rate that will allow the Work to be completed on time.

1.2 CPM SCHEDULING REQUIREMENTS

.1 The schedules required by this Section shall take the form of time-scaled diagrams prepared using a computerized scheduling system, capable of producing resource-and/or cost-loaded Critical Path Method (CPM) schedules.

.2 General requirements applicable to all schedules include the ability to:
- .1 Easily summarize, group, sort and filter activities by area, phase or other categorization as applicable, or any combination thereof;
- .2 Electronically compare any given schedule with any previous or subsequent update;
- .3 Generate monthly progress claims and cash flow projections through resource and cost loading activities;
- .4 Show schedules in bar chart, network diagram and time scaled logic diagram formats;
- .5 Apply different calendars to applicable activities; and
- .6 Transmit schedules electronically via e-mail attachments.

.3 Provide level of detail for project activities such that sequence and interdependency of Contract tasks are demonstrated and allow coordination and control of project activities. Show continuous flow from left to right.

.4 Float is defined as the amount of time between the earliest start date and the latest start date of an activity or chain of activities on the CPM schedule. Ensure activities with no float are calculated and clearly indicated on logical CPM construction network system as being, whenever possible, continuous series of activities throughout Contract Time to form "Critical Path".

.5 Use of float suppression techniques such as software constraints, preferential sequencing, special lead/lag logic restraints, extended activity times, or imposed dates, other than as required by the Contract, shall be cause for the rejection of any schedule submitted by the Contractor.

1.3 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00.

.2 Schedules shall be submitted to the Consultant in both PDF format and original software data file format within 10 days of Contract Award for Owner/Consultant review.

.3 Owner and Consultant will review schedule and return review copy within 10 days after receipt.

.4 Resubmit finalized schedule within 7 days after return of review copy.

.5 Electronic schedule submissions shall be in an original scheduling software data file type that permits modification of the layouts and data. In case of a discrepancy between an original software file and PDF schedule, the PDF of the schedule shall govern.

.6 Include costs for execution, preparation and reproduction of schedule submittals in tendered price.

.7 Submission of the schedules referred to in this Section shall constitute the Contractor's representation that:

- .1 Contractor and its Sub-Contractors intend to execute the Work in the sequence indicated on such schedule;
- .2 Contractor has distributed the proposed schedule to its Sub-Contractors for their review and comment, and has obtained their concurrence;
- .3 All elements of the Work required for the performance of the Contract are included. Failure to include any such element shall not excuse the Contractor from completing the Work within the Contract Time and within any other constraints specified in the Contract;
- .4 Seasonal weather conditions have been considered and included in the planning and scheduling of the Work influenced by high and low ambient temperatures and/or precipitation;
- .5 Contractor has thoroughly inspected the Site and has incorporated any other special conditions in planning the Work such as specified or required non-work periods, etc.
- .6 Consultant review time of submittals and shop drawings as specified has been accounted for in project schedule.

.8 Cash flow diagram:

- .1 Contractor shall submit an updated cash flow diagram quarterly.
- .2 Cash flow diagram shall be in format acceptable to the Owner.
- .3 Cash flow diagram shall represent Contractor's anticipated invoicing.

1.4 QUALITY ASSURANCE

.1 Use experienced personnel, fully qualified in planning and scheduling to provide services from the commencement of the Work through to the issuance of the Completion Payment Certificate.

1.5 PRELIMINARY AS-PLANNED SCHEDULE

.1 Meet with Owner and Consultant within 5 working days of Contract award, to discuss proposed approach for undertaking the Work, inclusive of methodology, sequencing, Construction Equipment, and labour resources to be utilized.

.2 Prepare a detailed CPM schedule (the preliminary as-planned schedule), illustrating the Contractor's plan for executing the Work, indicating the times for starting and completing the various stages of the Work and any applicable constraints. The preliminary as planned schedule should refine and amplify the Contractor’s tender schedule and must provide sufficient detail of the critical events and their interrelationship to demonstrate that the Work will be performed within the Contract Time.

.3 The preliminary as-planned schedule shall cover all phases of the Work and shall represent a practical plan to complete the Work, considering restrictions of access and availability of Work areas, and availability and use of manpower, materials and equipment. The preliminary as-planned schedule shall show the activity duration, sequencing and interdependencies for the following:

.1 Preparation of Shop Drawings and material samples;
.2 Review and approval of Shop Drawings and material samples;
.3 Permitting;
.4 Material procurement;
.5 Fabrication;
.6 Temporary works;
.7 Installation;
.8 Inspection/testing; and
.9 Handover.

.4 Each activity shall be coded by the performing entity such as a particular Sub-Contractor, supplier, the Consultant, etc.

.5 The activities defined in the preliminary as-planned schedule shall represent the planned durations in anticipation of normal manpower and equipment utilization in durations of whole working days. Except for non-construction activities, such as procurement, delivery or submittals, no activity durations shall exceed 15 working days unless approved by the Consultant. The durations shall be determined based upon resource planning under contractually-defined on-site work conditions. In calculating activity durations, normal inclement weather shall be considered. The Contractor shall schedule the Work to minimize the effect of adverse weather, and to allow for protection of the Site from such effects.

.6 The total number of activities and the distribution of activities shall reflect the complexity of the Work and shall be finite, measurable, identify a specific function and identify a trade responsible for its completion.

.7 Prepare a narrative to accompany the preliminary as-planned schedule that provides a detailed description of the labour, materials, plant, means and methods that the Contractor intends to utilize in carrying out the Work to achieve the planned rates of production required to support the activity durations shown in the schedule. The narrative shall also provide explanations supporting the use of lead-lag relationships and, where permitted, constrained dates.

1.6 PRELIMINARY AS-PLANNED SCHEDULE SUBMISSION AND REVIEW

.1 Within 15 working days after Contract award, submit to the Consultant:
- .1 One electronic copy of the preliminary as-planned schedule, clearly labelled with data date, specific update, and person responsible for update.
- .2 One electronic copy of bar chart identifying coding, activity durations, early/late and start/finish dates, total float, completion as percentile, current status and budget amounts.
- .3 One electronic copy of network diagram showing coding, activity sequencing (logic), total float, early/late dates, current status and durations.
- .4 One electronic copy of written narrative as described in paragraph 1.5.7 above.

.2 The Owner and the Consultant will review and return the preliminary as-planned schedule within 5 working days after receipt.

.3 The preliminary as-planned schedule must be acceptable in principle to the Owner and the Consultant, prior to the release of the first progress payment.

1.7 FINAL AS-PLANNED SCHEDULE AND CASH FLOW

.1 The Contractor shall submit all revisions and/or additional information requested by the Owner or the Consultant pursuant to their review of the preliminary as-planned schedule if the Consultant considers that these additions are necessary for the preliminary as-planned schedule to comply with the requirements of this Section. The required revisions must be made, and the as-planned schedule finalized to the satisfaction of the Owner and the Consultant (whereupon it will become the final as-planned schedule, against which progress will be measured) within 30 working days after Contract Award.

1.8 FINAL AS-PLANNED SCHEDULE SUBMISSION, REVIEW AND APPROVAL

.1 The Consultant will accept the final as-planned schedule if it demonstrates that the Work will be performed in an orderly manner and in conformity with the Contract Time, subject to the constraints set out in the Contract, but such acceptance will neither impose on the Owner or the Consultant responsibility for the sequencing, scheduling or progress of the Work nor interfere with or relieve the Contractor from the Contractor's full responsibility therefore. Acceptance of the final as-planned schedule or any subsequent update by the Owner shall not be construed as a confirmation that the schedule is a reasonable plan for performing the Work.

.2 Acceptance of final as-planned schedule showing scheduled Contract duration shorter than specified Contract duration does not constitute change to Contract Time.

.3 Consider final as-planned schedule showing Work completed in less than specified Contract duration, to have float.

1.9 COMPLIANCE WITH CONTRACT SCHEDULE

.1 The Contractor shall adhere to latest schedule approved by the Consultant.

.2 The express or implied acceptance by the Owner or the Consultant of the final as-planned schedule and any progress schedules shall not constitute an approval or acceptance of the Contractor's construction means, methods, or sequencing or its ability to complete the work in a timely manner and shall not place any obligation or responsibility on Owner towards the Contractor nor in any way limit the Contractor's obligations and responsibilities.

1.10 PROGRESS MONITORING

.1 Monitor progress of Work in detail to ensure integrity of critical path, by comparing actual completions of individual activities with their scheduled completions and reviewing progress of activities that have started but are not yet completed. Monitoring should be undertaken sufficiently often so that causes of delays are immediately identified and removed if possible.

.2 On an ongoing basis, record "progress to date" on copy of schedule to be available at the Site. Inspect Work with the Owner and the Consultant at least bi-weekly to establish progress on each current activity.

1.11 UPDATES AND REVISIONS TO SCHEDULE

.1 The Contractor's schedule is to be updated and resubmitted to the Consultant as a progress schedule at least once per month, on a date to be mutually agreed by the Contractor and the Consultant, together with the related data and reports required by this Section. Updated schedule is to include a 2 week look-ahead schedule in the form of a bar chart.

.2 Each progress schedule shall record and report actual completion and/or start dates for each completed or in-progress activity, activity percent complete for in-progress activities and forecast completion dates for all activities that are not yet complete. Do not automatically update actual start and finish dates by using default mechanisms found in scheduling software. The progress schedule will show the projected completion date of the Work based on the progress information inserted into it, without changes to the schedule logic or the original duration of any activity. The Contractor shall use the retained logic option when executing schedule calculations. The final as-planned schedule (or an approved revision thereto) will be shown as a target schedule to indicate whether the current progress schedule remains on target, has slipped or is ahead of schedule.

.3 The Contractor may then, in a second and subsequent update to the progress schedule, incorporate any logic and duration changes that represent its revised planning, provided all such changes are identified and documented in the schedule narrative required to accompany the progress schedule, and are agreed to by the Consultant.

.4 If it appears that the progress schedule submitted by the Contractor no longer represents the actual sequencing and progress of the Work, the Consultant may instruct the Contractor to revise the progress schedule.

.5 In order to improve the schedule, eliminate unforeseen problems or reduce the time required for an activity, modifications to the schedule may be suggested by the Contractor, Sub-Contractors, Owner or Consultant during the execution of the

Contract, and such modifications may be implemented by mutual agreement. The Contractor shall submit to the Consultant for acceptance proposed adjustments to the final as-planned schedule or any subsequent updates that will not change the Contract Time.

.6 If, at any time, the work is behind schedule with respect to the progress schedule currently in force, and if the Consultant believes there is a risk of the Work not being completed within the Contract Time as a result of such delay, the Contractor shall take all necessary measures to make up for such delay either by increasing staff, plant or facilities, or by amending its work methods, whichever is applicable.

.7 In all cases of delay or potential delay, the Contractor shall keep the Owner and the Consultant informed of its intentions with regard to mitigation of such delay and the Owner's Consultant may, if it is deemed necessary, require the Contractor to revise all or part of its current progress schedule.

.8 The current Contract Schedule can only be revised as agreed with the Owner and the Consultant by Change Order or an accepted revision to the logical sequence of described construction operations.

.9 Once accepted, the revised schedule will become the current Contract Schedule against which progress is reported and to which subsequent updates will be compared. The new Contract Schedule will be clearly identified to show it as the current Contract Schedule.

.10 Where the progress schedule shows completion of the Contract, or of any interim milestone, later than the Contract or milestone completion dates, acceptance of such progress schedules and of the monthly progress report will not constitute acceptance of the delay by the Consultant or the Owner.

1.12 EXTENSIONS OF TIME

.1 Float shall not be for the exclusive use of either the Contractor or the Owner. Extensions to the Contract Time will be granted only to the extent that appropriate adjustments to the duration of the affected activity exceed the total float time along the affected paths of the progress schedule in force at the time a Change Order or Change Directive is issued.

.2 Submit to the Consultant, justification, project schedule data and supporting evidence for approval of extension to the Contract Time or interim milestone date when required. Include as part of supporting evidence:

- .1 Written submission of proof of delay based on revised activity logic, duration and costs, showing time impact analysis illustrating influence of each change or delay relative to approved Contract Schedule.
- .2 Prepared schedule indicating how change will be incorporated into the overall logic diagram. Demonstrate perceived impact based on date of occurrence of change and include status of construction at that time.
- .3 Other supporting evidence requested by the Consultant.

1.13 PROGRESS REPORTS

.1 Monthly progress reports shall be prepared by the Contractor and submitted to the Consultant in the form of one electronic copy of the relevant schedule files, to

demonstrate how the Work is actually progressing and the planned and detailed sequencing of the Work at the time of the report. The cut-off date for the monthly progress report shall be as instructed by the Consultant and the report shall be submitted no later than 10 Working Days after the cut-off date and accompanying the monthly progress draw.

.2 Each monthly progress report shall be in a format acceptable to the Owner, and shall be arranged according to the following headings and sub-headings:
- .1 Executive Summary.
  - .1 Activity to (date).
  - .2 Forecast activity to (date).
- .2 Project Cost Information:
  - .1 Budget Summary.
  - .2 Cash Allowance Log.
  - .3 Change Order Log.
- .3 Project Data:
  - .1 Project Schedule.
  - .2 Shop Drawing Log.
  - .3 Site Inspection Log.
  - .4 Site Testing Log.
- .4 Critical Issues Log.
- .5 Site Photos.

.3 Each monthly progress report shall include:
- .1 An updated progress schedule, comparing actual and target progress for all milestones and activities. Sort activities by activity identification number and accompany with descriptions. List early and late start and finish dates together with durations, codes and float.
- .2 Criticality report listing activities and milestones with up to 5 days of total float used as first sort for ready identification of near critical paths through entire project. List early and late starts and finishes dates, together with durations, codes and float for critical activities.
- .3 Progress report in early start sequence, listing for each trade, activities due to start, to be underway, or finished within 2 months from monthly update date. List activity identification number, description and duration. Provide columns for entry of actual start and finish dates, duration remaining and remarks concerning action required.
- .4 A schedule narrative, including:
  - .1 Detailed descriptions of progress, including each stage of procurement, fabrication, delivery to site, construction, installation, and testing;
  - .2 Discussion of the basis for any work sequencing, logic, interdependencies or original activity duration revisions incorporated into an updated progress schedule; and
  - .3 Comparisons of actual and planned progress, with a brief commentary on any actual or forecast delays or problems that might have an impact on the completion. date of the Work, and a discussion of the measures being (or to be) adopted to overcome these.
- .5 Charts showing the status of submittals, permits and approvals, utility relocations, purchase orders, manufacturing/fabrication and construction.

.6 For each fabricated item, the name and location of the fabricator, percentage progress, and the actual or expected dates of commencement of fabrication, Contractor's inspections, tests and delivery.

.7 Progress photographs taken, prepared, and submitted in formats specified, all in accordance with Section 01 33 00.

.8 RFI log.

.4 Timely submission of updates is of significant and crucial importance to the management of this project. Lack of or late receipt of updates diminishes their value to the Owner and the Consultant. Therefore, if the Contractor fails to submit any progress schedule or required revision to a progress schedule within the prescribed time period, the Owner, in its sole discretion, may hold back subsequent progress payments until the updated schedule is submitted or the revision is accepted.

1.14 REVIEW OF MONTHLY PROGRESS REPORTS

.1 The monthly progress reports and progress schedules will be used by the Owner and the Consultant to monitor the Contractor’s performance against the current Contract Schedule.

2 Products - Not Used

3 Execution - Not Used

END OF SECTION

1 General

1.1 ADMINISTRATIVE

.1 Make submissions reasonable promptness and in orderly sequence so as to not cause delay in 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 Work affected by submittal shall not proceed until review is complete.

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

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

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

.6 Notify Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are coordinated.

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

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.

.10 Keep one reviewed copy of each submission on-site.

.11 Submit all submittals other than samples as one single electronic PDF file.

.12 Name Submittal PDF files to include the following:
- .1 Submittal Number.
- .2 Spec Section Number.
- .3 Revision Number: Reflect the number of submissions, zero is indicating the first submission.
- .4 Description of Submission.
- .5 Example: Sub001_09 21 16_R0_Gypsum Wallboard Product Data.

.13 Submittals returned to the Contractor will have added text to the end of the file name indicating the review status of the Submittal.
- .1 Example: Sub001_09 21 16_R0_Gypsum Wallboard Product Data – [review status].

.14 Resubmit submittal shall maintain the original file name but revising the revision number.
- .1 Example: Sub001_09 21 16_R1_Gypsum Wallboard Product Data.

1.2 SUBMISSIONS SCHEDULE

.1 Within 4 weeks after award of Contract submit a submittal schedule itemizing submittal for review by Consultant.

.2 If either the Contractor or the Consultant so requests, they shall jointly prepare a schedule fixing the dates for submission and return of submittals.

.3 Allow 14 days for Consultant's review of each submission.

1.3 SHOP DRAWINGS AND PRODUCT DATA

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

.1 Reproduction of the Contract Drawings for use as shop drawings is not permitted.

.2 Produce shop drawings complete with Contractor’s, Sub-Contractor’s, Supplier’s, or Manufacturer’s, or Contractor’s retained Professional Engineer’s own title block and organization name on the shop drawings, and where required in the technical Specifications Sections, signed and stamped by the Contractor’s retained Professional Engineer.

.2 Arrange for the preparation of clearly identified shop drawings as the Consultant may reasonably request.

.3 Prior to submission to the Consultant, 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. Indicate the Contractor’s review of each shop drawing by stamp, date and signature of an authorized person.

.4 Submit shop drawings to the Consultant for his review with reasonable promptness and in orderly sequence so as to cause no delay in the work or in the work of other Contractors.

.5 Make changes in shop drawings which the Consultant may require consistent with the Contract Documents and resubmit unless otherwise directed by the Consultant. When resubmitting, notify the Consultant in writing of any revision other than those requested by the Consultant.

.6 Make shop drawings accurately to a scale sufficiently large to show pertinent features of the Work. Define the division of responsibility between different trades in the shop drawings.

.7 Show materials, methods of construction and attachment or anchorage, erection diagrams, connections and other details necessary to complete the work. Cross reference shop drawings to Drawings and Specifications.

.8 The review by the Consultant is for the sole purpose of ascertaining conformance with the general design concept. The review shall not mean that the Consultant approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor, and such review shall not relieve the Contractor

of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of the work of all subtrades and work of other Contractors.

.9 Any adjustments made on the shop drawings by the Consultant are not intended to change the Contract Price. If the Contractor deems that such adjustments effect the value of the work, he shall so state in writing before proceeding with the fabrication and installation of the work.

2 Products

2.1 TRANSMITTAL LETTER

.1 Accompany submissions with transmittal letter, in duplicate, containing:
- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address.
- .4 Identification and quantity of each shop drawing, product data and sample.
- .5 Identification for initial submission or resubmission.
- .6 Other pertinent data.

2.2 SHOP DRAWINGS

.1 Submissions shall include:
- .1 Date and revision dates.
- .2 Project title and number.
- .3 Name and address of:
  - .1 Sub-Contractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Operating weight.
  - .8 Wiring diagrams.
  - .9 Single line and schematic diagrams.
  - .10 Relationship to adjacent work.

.2 Shop Drawings: Submit one electronic copy of shop drawings for each requirement requested in Specification Sections and as Consultant may reasonably request.

.3 Product Data: Submit one electronic copies of product data sheets or brochures for requirements requested in Specification Sections and as requested by Consultant where shop drawings will not be prepared due to standardized manufacture of product.

.4 Delete information not applicable to project.

.5 Supplement standard information to provide details applicable to project.

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

.7 Shop drawings will be returned to the Contractor with one of the following notations:

.1 When stamped "REVIEWED", distribute additional copies as required for execution of the Work.

.2 When stamped "REVIEWED AS NOTED", ensure that all copies for use are modified and distributed, same as specified for "REVIEWED".

.3 When stamped "REVISE AND RE-SUBMIT", make the necessary revisions, consistent with the Contract Documents and submit again for review.

.8 Only use shop drawings bearing "REVIEWED" or "REVIEWED AS NOTED" on the Work unless otherwise authorized by the Consultant.

.9 Further revisions by Contractor on submittals bearing "REVIEWED" or "REVIEWED AS NOTED" are not permitted.

.10 Shop Drawings Indicating Engineering and Design to be Provided by the Contractor:

.1 Include seal and signature of a Professional Engineer registered in the Province of the Work.

.2 Submittals for items required to be sealed by Professional Engineer (or as otherwise indicated as engineered), shall be prepared under the direct control and supervision of a qualified Professional Engineer registered in the Place of the Work, and having minimum professional liability insurance required in accordance with the General Conditions, as amended.

.3 Design includes life safety, sizing of supports, anchors, framing, connections, spans, and as additionally required to meet or exceed requirements of applicable codes, standards, regulations, and authorities having jurisdiction.

.4 Engineered submittals shall include design calculations, complete with references to codes and standards used in such calculations, supporting the proposed design represented by the submittal. Prepare calculations in

a clear and comprehensive manner so that they can be easily reviewed. Incomplete or haphazard calculations will be rejected.

.5 The Professional Engineer responsible for the preparation of engineered submittals shall undertake periodic field review, including review of associated mock-ups, at locations wherever the work as described by the engineered submittal is in progress, during fabrication and installation of such work, and shall submit a field review report after each visit. Field review reports shall be submitted to the Consultant, to authorities having jurisdiction as required, and in accordance with the building code.

.6 Field reviews shall be at intervals as necessary and appropriate to the progress of the work described by the submittal to allow the Engineer to be familiar with the progress and quality of such work and to determine if the work is proceeding in general conformity with the Contract Documents, including reviewed shop drawings and design calculations.

.7 Upon completion of the parts of the Work covered by the engineered submittal, the Professional Engineer responsible for the preparation of the engineered submittal and for undertaking the periodic field reviews described above, shall prepare and submit to the Consultant and authorities having jurisdiction, as required, a letter of general conformity for those parts of the Work, certifying that they have been provided in accordance with the requirements both of the Contract Documents and of the authorities having jurisdiction over the Place of the Work.

.8 Costs for such field reviews and field review reports and letters of general conformity are included in the Contract Price.

2.3 SAMPLES

.1 At each major milestone stage, assemble and submit all relevant samples in context, at one time, in the following groups:

- .1 Exterior Materials and Finishes.
- .2 Interior Materials and Finishes.
- .3 Ceiling Systems and Light Fixtures.
- .4 Door Hardware.
- .5 Cover plates, grilles, etc., of Mechanical and Electrical Sections.

.2 Submit for review samples in triplicate as requested in respective Specification Sections and as Consultant may reasonably request. Label samples with origin and intended use.

- .1 Technical Specifications Section.
- .2 Product Manufacturer’s name and address.
- .3 Product Supplier’s name and address.

.3 Deliver samples prepaid to Consultant's business address.

.4 Notify Consultant in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.5 Unless custom or precise colour and pattern is specifically described in the Contract Documents, whenever a choice of colour or pattern is available in a product, submit accurate colour charts from the Manufacturer's standard range of colour and pattern charts to the Consultant for selection.

.1 Unless all available colours and patterns have identical costs and identical wearing capabilities and are identically suited for the installation, completely describe the relative costs and capabilities of each.

.6 Adjustments made on samples by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.

.7 Make changes in samples which Consultant may require, consistent with Contract Documents.

.8 Reviewed and accepted samples will become standard of quality of work and material against which installed Work will be verified.

2.4 PRE-CONSTRUCTION CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract and prior to commencing work, submit the following:
- .1 Workplace Safety and Insurance Board status.
- .2 Certified true copy of insurance.

2.5 TEST REPORTS

.1 Clearly show on each test reports or certification, the name and location of the Work, name and address of Contractor, quantity and date of shipment and delivery, and name of manufacturer or fabricating company. Ensure certificates are signed by an authorized representative of the manufacturing or fabricating company.

.2 Submit four hard copies, or one electronic copy of all test reports submitted with certificates of compliance showing date or dates of testing, the specified requirements for which the testing was performed and results of the test or tests.

2.6 CERTIFICATION OF PERSONNEL

.1 Provide certificates to establish qualifications of personnel employed on the Work where such certification is required by authorities having jurisdiction, by the Consultant or by the Contract Documents.

3 Execution

3.1 SUBMISSION

.1 Make submittals well in advance of schedule dates for fabrication, manufacture, erection and installation to provide adequate time for reviews, securing necessary approvals, possible revisions and resubmittals, placing orders, securing delivery and to avoid construction delays.

3.2 COMPLIANCE WITH REVIEWED SUBMITTALS

.1 The Work shall conform to reviewed submittals subject to the requirements of this Section. Remove and replace materials or assemblies not matching reviewed submittals at no increase in the Contract Time and at no additional cost to the Owner.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 Related Requirements Specified Elsewhere:
- .1 Inspections and testing required by the laws, ordinances, rules and regulations of authorities having jurisdiction:
  - .1 General Conditions of the Contract.
- .2 Verification by certification that specified Products meet requirements of reference standards:
  - .1 In applicable Sections of the Specification.
- .3 Testing, balancing and adjusting of equipment:
  - .1 In applicable mechanical and electrical Sections of the Specification.
- .4 Cutting and Patching:
  - .1 Section 01 31 13.
- .5 Submission of Inspection and Testing Reports:
  - .1 Section 01 33 00.

.2 Testing and inspecting services are required to verify compliance with specified requirements. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
- .1 Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of products.
- .2 Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality control procedures that facilitate compliance with the Contract Document requirements.
- .3 Requirements for Contractor to provide quality assurance and quality control services required by Consultant, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

.3 Travel Expenses: Where it is necessary for the Consultant and Owner to visit places away from the Place of the Work in order to supervise, inspect or witness testing activities of items of the Work, for compliance with the Contract Documents, the Contractor shall pay the travelling, lodging and food expenses of Consultant and Owner.

.4 Conflicting Requirements: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Consultant for a decision before proceeding.

1.2 DEFINITIONS

.1 Quality Assurance: Activities, actions, and procedures performed before execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

.2 Quality Control: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the

Work and completed construction comply with requirements. Services do not include Contract enforcement activities performed by Consultant.

.3 Sample Installations: Full-size, physical assemblies that are constructed on-site. Sample installations are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved sample installations establish the standard by which the Work will be judged.

.4 Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

.5 Testing Agency: An independent agency engaged to perform specific tests, inspections, or both.

.6 Experienced: An entity having successfully completed previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 TOLERANCES FOR INSTALLATION OF WORK

.1 Unless acceptable tolerances are otherwise specified in a Section or a reference standard or are otherwise required for proper functioning of equipment, site services, and mechanical and electrical systems:

.1 "plumb and level" shall mean plumb or level within 3mm in 3048mm (1/8" in 10').

.2 "square" shall mean not in excess of 10 seconds lesser or greater than 90 degrees.

.3 "straight" shall mean within 3mm (1/8") under a 3048mm (10') long straight edge.

1.4 QUALITY ASSURANCE

.1 General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

.2 Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

.3 Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

.4 Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

.5 Professional Engineer Qualifications: A professional Engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

.6 Specialists: Contract Documents may require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated. Requirement for specialists shall not supersede requirements of authorities having jurisdiction.

.7 Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated, and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

.8 Manufacturer's Representative Qualifications: An authorized representative of Manufacturer who is trained and approved by Manufacturer to inspect installation of Manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

.9 Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

.1 Contractor responsibilities include the following:

.1 Provide test specimens representative of proposed products and construction.

.2 Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

.3 Provide sizes and configurations of test assemblies, mock-ups, and laboratory mock-ups to adequately demonstrate capability of products to comply with performance requirements.

.4 Build site-assembled test assemblies and mock-ups using Installers who will perform same tasks for Project.

.5 Build laboratory mock-ups at testing facility using personnel, products, and methods of construction indicated for the completed Work.

.6 When testing is complete, remove test specimens, assemblies, mock-ups, and laboratory mock-ups; do not reuse products on Project.

.2 Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Consultant with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.5 CONSTRUCTION REVIEW

.1 The Consultant and his Sub-Consultants may carry out construction review during the progress of the Work. The Consultant's general review during

construction, and inspection and testing by independent inspection and testing companies reporting to the Consultant, are both undertaken to inform the Owner of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve him of contractual responsibility.

.2 Bring to the attention of the Consultant any defects in the work or departures from the Contract Documents which may occur during construction. The Consultant will decide upon corrective action and state his recommendations in writing.

.3 The Consultant may appoint and direct inspection and testing companies to review completed work in addition to inspection and testing specified for inclusion in the work under Source and Field Quality Control in other Sections.

1.6 QUALITY CONTROL – OWNER'S TESTING

.1 General: The Owner may require, during progress of the Work, testing and inspection by an independent testing company as directed by the Consultant, or as required in Contract Documents, to determine if Work meets the specified requirements.

- .1 Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
- .2 If upon examination work is found in non-conformance to Contract Documents, Contractor shall correct such Work and pay cost of retesting and reinspection.
- .3 If such Work is found in conformance to Contract Documents, Owner shall pay cost of examination and replacement.
- .4 Retesting and Reinspection: When initial tests indicate non-compliance with the Contract Documents, costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be the responsibility of the Contractor. Retesting and reinspection shall be performed by the same testing agency as the initial tests.
- .5 If Contractor covers or permits to be covered Work that has been designated for tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.2 Testing Agency Responsibilities

- .1 Cooperate with Consultant and Contractor in performance of duties. Provide qualified personnel and equipment to perform required tests and inspections.
- .2 Notify Consultant and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
- .3 Determine the location from which test samples will be taken and in which in-situ tests are conducted.
- .4 Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
- .5 Submit certified written report, in triplicate, of each test, inspection, and similar quality-control service to the Consultant.

.6 Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.

.7 Do not perform any duties of Contractor.

.3 Contractor Responsibilities

.1 Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

.1 Access to the Work.

.2 Incidental labour and facilities necessary to facilitate tests and inspections.

.3 Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.

.4 Facilities for storage and field curing of test samples.

.5 Delivery of samples to testing agencies.

.6 Preliminary design mix proposed for use for material mixes that require control by testing agency.

.7 Security and protection for samples and for testing and inspecting equipment at Project site.

.2 Coordination: Coordinate sequence of activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

.1 Schedule times for tests, inspections, obtaining samples, and similar activities.

.3 Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality assurance and quality control services required. Submit schedule within 30 days of date established for commencement of the Work.

.1 Distribution: Distribute schedule to Owner, Consultant, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

.2 Establishing Schedule: Determine the time required for the agencies to perform their duties and the time required for the issuance of resulting reports. Allow for the times in the construction schedule.

.3 Schedule Revisions: Co-ordinate revisions with the testing and inspection agencies when changes to the construction schedule are necessary.

.4 Schedule Adherence: Provide advance notice to the testing laboratory and to the inspection company of when testing of the Work is required. If the testing laboratory is ready to perform its functions according to the schedule and is prevented from doing so due to incompleteness of the work, extra costs for testing attributable to the delay will be back charged to the Contractor.

1.7 QUALITY CONTROL - CODE AND CONTRACT COMPLIANCE, AND CONTRACTOR'S CONVENIENCE TESTING

.1 Code Compliance Testing: Inspection and tests required by codes or ordinances, or by an authority having jurisdiction shall be the responsibility of the Contractor and shall be paid for by the Contractor.

.2 Contract Compliance Testing: Inspection and tests required by Contract Documents shall be the responsibility of the Contractor and shall be paid for by the Contractor. These services include and not limited to the following:

.1 Mill Tests.
.2 Mix Designs.
.3 Building Systems Performance, Adjustments and Balancing Reports.

.3 Contractor's Convenience Testing: Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor and paid for by Contractor as part of the Contractor.

.4 Engage a qualified testing agency to perform these quality-control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

.5 Submit a certified written report, in triplicate, of each quality-control service.

.6 Submit additional copies of each written code compliance report directly to authorities having jurisdiction, when they so direct.

.7 Retesting/Reinspecting: Provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with code requirements and Contract Documents. Retesting and reinspection shall be performed by the same testing agency as the initial tests.

.8 Manufacturer's Field Services: Where indicated, engage a factory authorized service representative to inspect field-assembled components and equipment installation, including service connections.

1.8 SAMPLE INSTALLATIONS

.1 Construct sample installations for Work specifically requested in Specifications. Include for Work of all Sections required to provide sample, installations. Obtain Consultant's approval of sample installations before starting work, fabrication, or construction.

.2 Construct in locations acceptable to Consultant with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.

.3 Failure to construct sample installations 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.

.4 If requested, Consultant will assist in preparing a schedule fixing dates for sample installation construction.

.5 Maintain sample installations during construction in an undisturbed condition as a standard for judging the completed Work.

.6 Specification Sections identify whether sample installations may remain as part of Work or to be removed.

2 Products

2.1 TEST AND INSPECTION LOG

.1 Prepare a record of tests and inspections. Include the following:
- .1 Date test or inspection was conducted.
- .2 Description of the Work tested or inspected.
- .3 Date test or inspection results were transmitted to Consultant.
- .4 Identification of testing agency or special Inspector conducting test or inspection.

.2 Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Consultant's reference during normal working hours.

3 Execution

3.1 REPAIR AND PROTECTION

.1 On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

.2 Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.

.3 Protect construction exposed by or for quality-control service activities.

.4 Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

3.2 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Consultant as failing to conform to Contract Documents. Replace in accordance with Contract Documents.

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

.3 If in opinion of Consultant, it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner may deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Consultant.

END OF SECTION

1 General

1.1 AUTHORITIES HAVING JURISDICTION

.1 Where reference is made to "authorities having jurisdiction", it shall mean all authorities who have within their constituted powers the right to enforce the laws of the place of the building.

1.2 DEFINITIONS

.1 The "Constructor" named in the latest addition of The Occupational Health and Safety Act, and the Workplace Safety and Insurance Board (WSIB) Regulations, of the Province of the place of the Work, including any amendments, shall mean the "Contractor" for the work performed under this Specification.

1.3 FIRE PREVENTION AND SAFETY

.1 Enforce fire protection methods, good housekeeping, and adherence to local and underwriter's fire regulations. Provide ULC approved fire extinguishers, and other fire fighting services and equipment except where more explicit requirements are specified as the responsibility of individual Sections.

.2 Maintain clear emergency exit paths for personnel at all times.

.3 Use only fire-resistant tarpaulins and similar protective covering on-site.

1.4 FIRE PROTECTION OF STRUCTURE

.1 Ensure that nothing subverts the integrity of fire protection provided for the building structure.

.2 Provide fire protection of structural members for their entire length and girth.

.3 Coordinate work of all Sections so that they do not encroach on space required for fire protection and its installation. Ensure that fire protection damaged during construction is totally replaced.

1.5 FIRE SEPARATIONS

.1 Ensure that fire separations are installed to maintain total integrity and that they are not diminished or breached by work following their installation.

.2 Replace fire separations which have suffered a lessening of their required rating during construction.

1.6 WASTE MANAGEMENT

.1 Comply with all applicable regulations and requirements of the place of the Work. Waste Audits and Waste Reduction Workplans, Industrial, Commercial and Institutional Source Separation Programs under the Environmental Protection Act of the place of the Work, including preparing and submitting waste audit and reduction plan specified in Section 01 74 00.

1.7 ENERGY EFFICIENCY

.1 The building has been designed and will be constructed by the Contractor to high quality engineering practice as described in ASHRAE/IES 90.1, "Energy Efficient Design of New Buildings Except Low-rise Residential Buildings" as interpreted by the "Guidelines for the Interpretation of ASHRAE/IES 90.1".

1.8 REQUIREMENTS OF REGULATORY AGENCIES

.1 Work shall include protection measures consisting of materials constructions and methods, and first-aid equipment and personnel, required by the latest edition of The Occupational Health and Safety Act, and the Workplace Safety and Insurance Board (WSIB) Regulations, of the Province of Ontario, and as otherwise imposed by authorities having jurisdiction to save persons and property from harm.

.2 Ensure that pollution, noise pollution and environmental control of construction activities are exercised as required during the work.

.3 Except where special permission is obtained, maintain clear access for roads and sidewalks on public property.

.4 Maintain all (Municipal and Provincial) roads and sidewalks clear of construction materials and debris, including excavated material. Clean roads and sidewalks as frequently as required to ensure that they are cleared of materials, debris and excavated material.

.5 Remove snow and ice from sidewalks as required and to the standards acceptable by the Municipality.

1.9 REFERENCE STANDARDS

.1 Where edition date is not specified, consider that references to Manufacturer's and, published codes, standards and specifications are made to the latest edition (revision) approved by the issuing organization, current at the date of this Specification.

.2 Reference standards and specifications are quoted in this Specification to establish minimum standards. Work of quality or of performance characteristics that exceeds these minimum standards will be considered to conform.

.3 Should the Contract Documents conflict with specified reference standards or specification, the General Conditions of the Contract shall govern.

.4 Where reference is made to manufacturer's directions, instructions or specifications they shall include full information or storing, handling, preparing, mixing, installing, erecting, applying, or other matters concerning the materials pertinent to their use and their relationship to materials with which they are incorporated.

.5 Have a copy of each code, standard and specification, and manufacturer's directions, instructions and specifications, to which reference is made in the Specifications, always available at construction site.

.6 Standards, specifications, associations, and regulatory bodies are generally referred to throughout the specifications by their abbreviated designations. These are as follows:

AA	The Aluminum Association
AAMA	American Architectural Manufacturer's Association (USA)
ACI	American Concrete Institute
AISI	American Iron and Steel Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWMAC	Architectural Woodwork Manufacturers Association of Canada
AWS	American Welding Society (USA)
CGSB	Canadian General Standards Board
CISC	Canadian Institute of Steel Construction
CLA	Canadian Lumbermans' Association
CPMA	Canadian Paint Manufacturers Association
CRCA	Canadian Roofing Contractors Association
CSA	Canadian Standards Association
CSSBI	Canadian Sheet Steel Building Institute
FM	Factory Mutual
GANA	Glass Association of North America
MPI	Master Painters Institute
MTO	Ministry of Transportation of Ontario
NAAMM	National Association of Architectural Metal Manufacturer's
NBC	National Building Code
NEMA	National Electrical Manufacturer's Association
NFC	National Fire Code of Canada
NFPA	National Fire Protection Association (USA)
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
NRC	National Research Council
OAA	Ontario Association of Architects
OBC	Ontario Building Code
OFC	Ontario Fire Code
OGCA	Ontario General Contractors Association
OPCA	Ontario Painting Contractors Association
OPSS	Ontario Provincial Standard Specification
OIRCA	Ontario Industrial Roofing Contractors Association
PEI	Porcelain Enamel Institute (USA)
SAE	Society of Automotive Engineers
SJI	Steel Joist Institute
SSPC	Steel Structures Painting Council
TTMAC	Terrazzo, Tile and Marble Association of Canada
ULC	Underwriters Laboratories of Canada
ULI	Underwriters Laboratories Incorporated (USA)

2 Products - Not Used

3 Execution -Not Used

END OF SECTION

1 General

1.1 GENERAL

.1 Include in the Work construction of temporary facilities as required for the performance of the Work as construction aids and as required by authorities having jurisdiction, or as otherwise specified. Install to meet needs of construction as Work progresses. Maintain construction and temporary facilities during use, repair them when damaged, relocate them as required by the Work, remove them at completion of need, and make good adjacent work and property affected by their installation.

.2 Include in the Work, construction of temporary facilities to provide for construction safety such as: fences, barricades, bracing, supports, storage, sanitation and first aid facilities, fire protection, stand pipes, electrical supply, temporary heat, steam supply, ventilation, construction equipment with its supports and guards, stairs, ramps, platforms, runways, ladders, scaffolds, guardrails, temporary flooring, rubbish chutes, and walkway, morality and guard lights, all as required of the construction by the Occupational Health and Safety Act of the Province of Ontario, latest edition, as well as all other regulations of the authorities having jurisdiction.

.3 Construct temporary work of new materials unless otherwise approved.

.4 Ensure that structural, mechanical, and electrical characteristics of temporary facilities are suitable and adequate for the use intended. Be responsible that no harm is caused to persons and property by failure of temporary facilities because of placing, locations, stability, protection, structural sufficiency, removal, or any other cause.

.5 Prepare shop drawings and Specifications of temporary work and submit for approval of authorities having jurisdiction if so required. Submit duplicate copy to Consultant for his information.

.6 Locate temporary facilities where shown on Drawings or as directed.

.7 Apply two coats of paint, in approved colours, to temporary constructions, such as storage sheds; offices; supports; bracing and back side of signs; barricades; and where otherwise specified.

.8 Temporary Electric Service:

- .1 Provide and maintain an adequate temporary electrical service for performance of the Work including, but not limited to, operation of electric pumps, motors, vibrators and other power tools, hoisting and related construction and general illumination during the Work. Provide power at temporary storage sheds and field office when required.
- .2 Make connections available to any part of the work within distance of a 3048mm (10') extension. Each Sub-Contractor shall be responsible for their own extension cords.
- .3 Contractor shall provide and be responsible for payment of temporary power required for all equipment for construction use in excess of available existing sources.
- .4 Provide and maintain any components and equipment necessary to transform supply power to necessary temporary power voltage.

.5 Contractor will be permitted use of existing power for construction purposes at no cost to the Contractor. Provide additional temporary power for individual tasks required by the technical Sections.

.9 Temporary Lighting:

.1 Install lighting for the following:

.1 Emergency evacuation, safety and security throughout the Project at intensity levels required by authorities having jurisdiction.

.2 Performance of work throughout work areas as required, evenly distributed, and at intensities to ensure proper installations and applications are achieved.

.3 Performance of finishing work in areas as required, evenly distributed, and of an intensity of at least 30’ candles.

.2 Permanent lighting may be used during construction, provided lamps, fluorescent tubes and ballasts that are so used are replaced with new at time work is turned over to Owner.

.10 Temporary Heating and Ventilation:

.1 Provide and pay for temporary heating, cooling and ventilating required for the Work, including attendance, maintenance and fuel.

.2 Provide temporary heat and ventilation as required to:

.1 Facilitate continuous uninterrupted progress of the Work.

.2 Protect the Work and Products against damage and defacement caused by weather, harmful levels of temperature, humidity, and moisture.

.3 Provide ambient temperatures and humidity levels for proper storage, installation and curing of materials, in accordance with specified standards and Manufacturer's requirements.

.4 Provide adequate ventilation to meet health regulations for safe working environment.

.3 Maintain work areas at not less than 7°C. Increase temperatures in isolated areas to 20°C as required by various Sections of the Specifications or by Product Manufacturers.

.4 Solid fuel salamanders will not be permitted.

.5 Provide temporary heat or adequate protection by means of straw or other coverings to floor slabs, footings, or any part of building not specifically designed to withstand frost penetration.

.6 Furnish other temporary heating as required by various Sections of the Specifications or by Product Manufacturers.

.7 Replace with new, any work damaged due to failure to provide adequate heat at no cost to Owner.

.8 If possible, and when approved by the Owner, the permanent heating and ventilation system may be used during construction. If approved, the Contractor shall be responsible for its operation, and for replacing and repairing damage it may suffer, and shall assume operation and maintenance of the system in all its parts and payment for fuel consumed.

.9 Operation and maintenance shall include inspection at least every 2 weeks of thermostats, valves, switches, lubrication, fan, belt and motor adjustment, cleaning and/or replacement of filters, and replacement of filters and re-servicing of system at completion of Work.

.10 Connect electric motors only to permanent source of power, or otherwise provide proper source with correct design characteristics and with no fluctuation in voltage.

.11 Commence warranty period after re-servicing and from time the Owner takes over the premises.

.11 Temporary Water Supply:

.1 Provide water of potable quality for all construction purposes, at one location at least, on each floor area.

.2 Extend supply pipe or pipes from nearest available sources and maintain in good condition until no longer required.

.3 If possible, and when approved by the Owner, the permanent Site water source be used to provide water during construction.

.12 Temporary Sanitary Facilities:

.1 Provide sanitary facilities for persons on the Work Site as approved by the authorities having jurisdiction. Install them in sufficient number and maintain them in a sanitary condition.

.2 Do not permit construction personnel to use washroom and toilet facilities on premises which have been installed as part of the new work or which are part of the existing building for use by non-construction personnel.

.13 Connections to Utilities:

.1 Make arrangements for connections to water, sewer, gas, electric, and telephone utilities as required for temporary use during construction.

.2 The Owner is responsible for payment of final connection charges that are part of service contracts between him and each utility.

1.2 CONSTRUCTION AIDS

.1 Hoists and Cranes:

.1 Each Sub-Contractor is responsible for providing his own hoisting and crane operations. Equipment shall be operated by qualified hoist and/or crane operators.

.2 Where multiple trades are involved in high level work, the Contractor shall co-ordinate the hoisting and trade requirements.

.2 Building Enclosure:

.1 Include in Work, temporary enclosures for building as required to protect it, in its entirety or in its parts, against the elements, to maintain environmental conditions required for Work within the enclosure, and to prevent damage to materials stored within. Design enclosures to withstand wind pressures required for the building by authorities having jurisdiction.

.2 Use structural framing of building for support of temporary enclosure framing only upon verification that the load limits of the building frame will not be exceeded. Erect enclosures to allow complete accessibility for installation of materials during the time enclosures remain in place.

.3 Scaffolding:

.1 Each Sub-Contractor shall provide his own scaffolding.

.2 Scaffolding shall be erected clear of walls, and to ensure that it does not interfere with continuing work.

.3 Sub-Contractor shall be responsible for its examination for sufficiency of his scaffolding and be responsible for accidents due to its insufficiency.

.4 The Contractor will be responsible for co-ordination of scaffold work if multiple trade usage can be achieved from one installation.

1.3 TEMPORARY BARRIERS

.1 Provide temporary hoarding and fencing as specified in Section 01 56 00 and complying with the local Building Code, all other by-laws of the municipality and all other authorities having jurisdiction.

1.4 PROTECTION

.1 Provide temporary protection to construction as required by the Work, to protect it from damage.

.2 Box with wood or otherwise protect from damage, by continuing construction, finished sills, jambs, corners, and the like.

.3 Adequately protect the Work at all stages of operations and maintain protection until the Work is completed. Remove and replace, at no additional cost to Owner, damaged Work and materials that cannot be repaired or restored to the approval of the Consultant.

.4 Provide spare safety helmets for and enforce their use by Owner, Consultants, and representatives and authorized visitors to the Site.

.5 In addition to requirements of authorities having jurisdiction, provide temporary protection and safeguards adequate to protect against:

.1 Accident or injury to workers and other persons on the Site or adjacent work and properties.

.2 Damage to any part of the Work and to any adjoining or adjacent structure, property, services, and other similar items, by overloading, weather, frost, any other cause resulting from the execution of the Work.

.3 Protect Work, existing property, adjacent tenant and public property from damage during performance of Work. Should any part of the Work or any buildings, services or similar items on or surrounding the areas of the Work and adjacent to any road leading thereto become damaged or disfigured due to lack or failure of such protection, they shall be made good with material identical with the existing and adjoining surfaces, to the satisfaction of the authorities having jurisdiction and the Owner.

.4 Damaged work shall be made good by those performing work originally, or workers experienced or skilled in that particular type of work, at expense of those causing damage.

.5 Provide and maintain necessary temporary enclosures, hoardings, fences, gates, barriers, guards, hoists, cranes, stairs, ladders and scaffolding, walks, platforms, staging as necessary for the Work and protection of workers, public and others from injury, and for public access to adjacent buildings. All such apparatus shall meet requirements of the authorities having jurisdiction.

.6 Provide secure, rigid guard railings, hoardings and barricades around openings, as required by authorities having jurisdiction and to maintain safety.

.7 Provide proper guard devices, signs, signals and lights for the prevention of accidents.

.8 Maintain at night, sufficient and suitable warning lights to prevent accidents and injuries to persons and/or property.

.9 Alter, remove and relocate or replace hoardings, barriers and entrances as required by the Work. Hazards requiring such protection shall be eliminated as soon as possible and protection devices removed. Maintain protection until state of construction allows their removal.

.10 Provide and maintain temporary weathertight protection for all exterior openings in walls, floors and roofs until the building is closed in.

.11 Close off floor areas where walls are not finished, seal off openings and enclose building interior work area. Polyethylene or other approved translucent material shall be framed in or around wall openings. Provide temporary doors, frames, hinges, locks, keys and bolts as required.

.12 Should the Work be stopped for any cause, provide protection and bracing for the Work.

.6 Lay protective 13mm (1/2") plywood over completed areas of roof on which other trades are to work.

1.5 PUBLIC PROTECTION

.1 Provide fencing, barricades, hoarding, notices and warning boards and maintain lights and signals for protection of workers engaged on the Work, for protection of adjoining property and for protection of the public.

.2 Such protective measures shall be finish painted to Owner’s approved colour, when visible to the public.

.3 Where any special hazard exists from which it is not possible to protect the public safety by other means, watchpersons shall be employed to preserve public safety until the area of special hazard no longer poses a risk to public safety.

1.6 PLANT PROTECTION

.1 Protect all existing trees, shrubs and landscaping which is to remain at the Place of the Work, using methods and materials recommended by the Canadian Nursery Trades Association and as approved by the Consultant. Do not remove interfering branches adjacent to excavation without obtaining prior approval from Consultant. Do not injure tree trunks.

.2 Wrap in burlap, trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2440mm (8'). Protective wood framework to include 38mm x 89mm (2" x 4") lumber around tree at 150mm (6") o.c. Hold framework in place with minimum of 3 suitable wire bands.

.3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage due to compaction of soil, excavating, backfilling and rough grading, and against oil, gasoline and other chemicals due to spillage

and for seepage. Avoid unnecessary traffic, dumping and storage of materials over root zones. Replace damaged trees as directed without any expense to Owner.

.4 Minimize stripping of topsoil and vegetation.

.5 Restrict tree removal to areas indicated or designated by Consultant.

1.7 FIRE SAFETY REQUIREMENTS

.1 Comply with fire and safety regulations required by the authorities having jurisdiction.

.2 Take necessary precautions to eliminate fire hazards and to prevent damage to Work, building materials, equipment and other property both public and private having to do with Work. Inspect Work at minimum weekly intervals for this purpose. Do not store combustible materials near or next to occupied areas of the building, or next to exit pathways.

.3 Store and locate Products and equipment packed in cardboard cartons, wood crates and other combustible containers in orderly and accessible manner.

.4 Tarpaulins shall be fire-resistant.

.5 Open fires and burning of rubbish are not permitted on the Site.

.6 Provide and maintain in working order, ULC labelled fire extinguishers or other approved fire extinguishing equipment, locate in prominent positions, in accordance with requirements of authorities having jurisdiction and insurance companies having jurisdiction, codes, regulations and bylaws in the building until the permanent fire protection system in the building is available.

.7 Provide temporary standpipe system, when required by authorities having jurisdiction.

.8 Except as otherwise specified herein, soldering, welding and cutting operations shall be carried out in areas free of combustible and flammable contents, with walls, ceilings and floors of non-combustible construction or lined with non-combustible materials.

.9 When it is not practicable to undertake welding, soldering and cutting operations in areas described in the previous paragraph, combustible and flammable materials shall either be removed minimum of 9144mm (30') from the work area or otherwise protected against ignition by sheet metal or other non-combustible material.

.10 When welding, soldering, or cutting is to be carried out near piping containing flammable gas, the section of piping located within 914mm (3') of the torch or other source of combustion shall be covered with wet, non-combustible insulating material at least 6mm (1/4") thick.

.11 Prior to initiating any open flame work or welding operation, discuss the proposed work with the Consultant and take necessary precautions to prevent inadvertent activation of the existing fire alarm system. Have sufficient suitable hand operated fire extinguishers on hand near the work area. Ensure that an

additional person is readily available to operate fire extinguishers should the need arise.

1.8 PERSONAL HEALTH AND SAFETY REQUIREMENTS

.1 Comply with all requirements of the Occupational Health and Safety Act, Ministry of Labour, Construction Safety Association and all other authorities having jurisdiction in the place of the Work.

.2 Contractor shall submit company safety policy for review by Owner and Consultant. The policy must meet or exceed the requirements of the authorities having jurisdiction.

.3 Contractor shall employ and pay for services of Safety Supervisor in accordance with the requirements of the authorities having jurisdiction. Safety Supervisor shall have training with the Construction Safety Association.

.4 Alcohol and/or drugs will not be allowed on the Site. Anyone found in possession of alcohol and/or drugs shall be dismissed from the Site immediately and without notice, maybe subject to civil and/or criminal proceedings.

.5 WHMIS program shall be fully enforced.

.6 Contractor shall be prepared to sign the "Guidelines For The Structure and Function Of The Joint Occupational Health and Safety Committee", if requested by the Owner.

.7 When carrying out soldering, welding or cutting procedures, be it in shop or in the field, ensure that workers comply with the following:

- .1 Wear appropriate protective clothing such as gloves, leather aprons and/or arm spark guards.
- .2 Wear suitable goggles or face shields as appropriate.
- .3 Protect co-workers from eye or other injuries through the use of fire-resistant portable shielding devices.
- .4 Provide and use a portable fume eliminator at all times during welding, soldering, or cutting operations within the existing building.

1.9 SECURITY

.1 Maintain security of construction site by control of access through enclosing barricades, and hoardings during times work is in progress, and by locking hardware.

.2 Properly close and lock the construction site at night, Sundays, holidays and other occasions when the Work is not in progress.

.3 The Owner assumes no responsibility for the safeguarding of tools or equipment from theft.

.4 Take precautions to guard construction site, premises, materials and the public during and after working hours. During regular working hours, maintain watch to guard construction site and contents.

.5 Maintain security at all times if construction is shut down because of a strike or a lockout.

.6 Provide security guards and security lighting during all after hour work.

.7 Provide personnel to direct traffic as required during working hours.

1.10 ACCESS ROADS, WALKS AND PARKING

.1 Access Roads and Walks:

.1 All construction vehicles and personnel required for construction shall use existing access roads and walks as determined at later date by Owner. When no longer required, or at completion of Work, make good, disturbed surfaces. Maintain roads and walks, removing dirt, mud, debris, ice, snow and other obstructions during use.

.2 Provide for access of emergency vehicles at all times.

.2 Parking:

.1 Parking for Contractor's, Sub-Contractors, Suppliers and/or their employee's vehicles shall be limited to restricted area as designated by the Owner.

.2 The Owner, property management and their employees will not be responsible for parking fines incurred by the Contractor, Sub-Contractors, Suppliers and/or their employees.

1.11 SITE SIGNS

.1 No signs, bills or posters will be allowed on the Site, other than Site signs as follows:

.1 Construct project identification site sign comprising foundation, framing, and one 1200mm x 2400mm signboard painted with exhibit lettering produced by a professional sign painter.

.1 Foundations: 15 MPa concrete to CAN/CSA-A23.1 minimum 200mm x 900mm deep.

.2 Framework and battens: SPF, pressure treated minimum 89 x 89mm.

.3 Signboard: 19mm Medium Density Overlaid Douglas Fir Plywood to CSA O121.

.4 Paint: alkyd enamel to CAN/CGSB-1.59 over exterior alkyd primer to CGSB 1-GP-189.

.5 Fasteners: hot-dip galvanized steel nails and carriage bolts.

.6 Indicate on sign, name of Owner, Consultant and Contractor, of a design style approved by Owner.

.7 Paint all surfaces of signboard and framing with one coat primer and two coats enamel.

.2 Place only specified Project construction sign and notices regarding safety, caution, or instructions on or near Site. Refer to Section 01 56 00 regarding signage on hoarding.

.3 No unauthorized signs, bills, posters or advertisements of any kind are permitted. Should such unauthorized advertisements be applied to the temporary hoarding by the public or anyone else, upon discovery of such, the Contractor shall remove them on a weekly basis.

.4 Erect all notices as directed by Owner.

.5 Remove all notices on completion of the Contract.

2 Products

2.1 TEMPORARY FIELD OFFICES AND STORAGE SHEDS

.1 Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading. Temporary site office shall not exceed 3048mm (10') x 15240mm (50').

- .1 Electrical Power Service: Provide 120V AC duplex receptacles, with not less than one receptacle on each wall of offices and meeting rooms.
- .2 Electronic Communication Service: Provide DSL line and temporary electronic communication service, including electronic mail, in each field office.
- .3 Telephone and Facsimile Services: Provide and maintain one telephone and one facsimile machine in each field office. Long distance charges shall be paid by those making calls and using facsimile machine.
  - .1 At each telephone, post a list of important telephone numbers such as Owner's and municipality's emergency services, and the police and fire departments.
  - .2 Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- .4 Cleaning Services: Employ professional cleaning services to maintain offices in sanitary conditions.

.2 Contractor's Field Office: Of sufficient size to accommodate needs of workers. Maintain office dry, clean, well-lighted, properly ventilated and heated to 20°C (68°F) complete with telephone and facsimile services. Furnish office tables, chairs, racks for drawings, filing cabinets and shelves. Install electrical lighting system to provide approved lighted environment.

.3 Common Use Field Office: Of sufficient size to accommodate needs of workers. Keep office clean and orderly. Furnish and equip offices as follows:

- .1 Furniture required for Project site documents including file cabinets, plan tables, plan racks, and bookcases. Locate the plan tables so that when Drawings are spread out their orientation is same as that of building under construction.
- .2 Conference room of sufficient size to accommodate meetings of 10 individuals. Furnish room with conference table, chairs, and 1200mm (48") square tack board.
- .3 Private washroom with continuous sanitary supplies.
- .4 Coffee machine and supplies.
- .5 Heating and cooling equipment necessary to maintain a uniform indoor temperature of 20° to 22°C.
- .6 Lighting fixtures capable of maintaining average illumination of 215 lx (20 fc) at desk height.

.4 Owner's Field Office: Provide a site office for the use of the Owner and Consultant. Keep office clean and orderly. Furnish and equip offices as follows:

- .1 Size: Minimum 37m² (400ft²) of floor area and 2400mm (8'-0") clear inside high, weathertight and soundly constructed.
- .2 Number of Rooms: One office, one meeting room, and one washroom.

.3 Windows and Doors: Minimum four 900mm x 1500mm (36" x 60") windows, one exterior door with lock and three keys and a slot with plywood mailbox and one interior door.

.4 Heating and Cooling: Maintain a uniform indoor temperature of 20° to 22°C.

.5 Lighting: Lighting fixtures capable of maintaining average illumination of 215 lx (20 fc) at desk height.

.6 Furnishings:

.1 Office: One desk not less than 900mm x 1800mm (36” x 72”) with drawers, two desk chairs, two x four compartment legal sized metal file cabinets,

.2 Meeting Room: One conference table and chairs to accommodate 10 individuals, two plan tables not less than 900mm x 3000mm (36" x 10'), coat closet with shelf 600mm x 600mm x 2400mm (24" x 24" x 96") high, one sample cupboard 750mm deep x 3600mm wide x 1800mm high (30” deep x 144” wide x 72” high) with 4 shelves and doors with locks and keys, one bookcase for Project Manuals, and two drawing racks.

.7 Private washroom with continuous sanitary supplies.

.8 Coffee machine and supplies.

.9 Paint interior and exterior annually.

.10 Submit plans and details of construction before fabrication.

.5 Keep temporary field office clean and remove all rubbish at the end of each workday.

.6 Include construction and operating hardware, with security locks, as required by the Owner.

.7 Storage Sheds: Lockable weather tight storage sheds with floors raised 150mm (6”) minimum above ground, for storage of materials, tools, equipment, which may be damaged by weather. Provide separate shed for paints and volatile materials. Provide fire extinguisher in each location and do not store combustible or hazardous materials in Building. Install lighting in storage areas and heat in those storage areas containing materials damaged by low temperature.

.8 Owner is not responsible for securing Products or materials at the Place of the Work.

.9 Handle and store materials so as to prevent damage or defacement to the Work and surrounding property.

3 Execution

3.1 SANITARY FACILITIES

.1 Provide and maintain temporary facilities in compliance with The Occupational Health and Safety Act, applicable codes and by-laws, sanitary facilities for use of workers. Provide portable, weatherproof toilets, serviced at least weekly, which may be replaced by adequate, permanent or temporary water closets, urinals and basins when plumbing system has been installed, tested and approved.

Workers’ use of new washroom facilities of this Project is strictly prohibited.

3.2 VEHICULAR ACCESS AND PARKING

.1 Access Road, Parking and Traffic Control

.1 Provide access roads as may be necessary to provide safe and adequate access for materials, products and other supplies. Provide and maintain access sidewalks, roadways, and similar facilities as may be required for access to the Work.

.2 Do not block public roads or impede traffic during work of this Project and if required to temporary block traffic then provide flag person to direct traffic acceptable to Municipal authorities. Remove accumulations of ice and snow from areas providing access to Site. Ensure that access is available for emergency vehicles. Comply with fire plan for vehicular traffic.

.3 Provide roads, walks, ramps, stairs and other such means of access as necessary. Maintain temporary entrances to building(s) including enclosed hoarding as required. Maintain access to existing service entrance(s) at all times, including ready access for fuel oil trucks and delivery vehicles. Bridge excavations with construction to safely support any load that could be imposed or provide personnel to assist in deliveries to building(s) as required.

.4 Do not be nuisance to public traffic any time. Manage construction traffic by using designated roads and by providing trained flag persons to direct public traffic as appropriate.

.5 Provide a hard surface area at the Place of the Work for cleaning down trucks prior to entry onto municipal roads or private roads outside of the Place of the Work.

.6 Keep public and private roads free of dust, mud and debris resulting from truck, machinery and vehicular traffic related specifically to this Project, for the duration of Work.

.7 Clean roads regularly, public or private. Wash down and scrape flush roads at least daily when earth moving operations take place. Maintain public property in accordance with requirements of authorities having jurisdiction.

.2 Construction Parking: Parking on site is limited to the space available. Owner will not be responsible for parking fines incurred by Contractor, Sub-Contractors or their employees.

3.3 POLLUTION CONTROL

.1 Provide dust tight screens or barriers to localize dust generating activities for the protection of tenants, employees, equipment, adjacent and finished areas of Work, and the public. Maintain and relocate protection until Work is complete. Respond immediately to complaints of dust received from the public, authorities having jurisdiction, Owner and Consultant.

.2 Painted gypsum wallboard and metal stud dustproof screens, shall extend to underside of structure, and shall be erected to protect adjoining areas and rooms. Apply bead of sealant or other acceptable seal continuously around periphery of each face of partitioning to seal gypsum board/structure junction where dustproof screens abut fixed building components. Seal perimeter of cut-

outs, around fixtures and fittings and other penetrations. Tape or seal between adjacent boards. Separate construction areas from occupied areas.

.3 Provide protection for existing equipment sensitive to dust and noise.

.4 Install temporary packing at bottom of doors to areas where demolition/construction shall be performed to prevent dust seepage into existing spaces. Do not permit dust and dirt to escape beyond area being constructed/altered.

.5 Provide daily vacuuming of construction dust from existing areas as work progresses; this shall be considered a minimum requirement, increase vacuuming as necessary. The Owner may have vacuuming work done by others and cost deducted from Contractor's progress payments if this requirement is not fulfilled.

.6 Provide locked doors in barriers to permit access by Consultant, Owner and Owner's security personnel to construction areas and to areas under Contractor's custody. Supply padlocks and construction cores.

.7 Remove dustproof screens at completion of work in areas and make good damaged or blemished areas. Patch and make good to access, altered and damaged areas caused by work and screens. Maintain integrity of fire or sound separation.

.8 Prevent nuisance to adjacent areas near the work from dust by taking additional appropriate anti-dust measures at such times as found necessary, and at other times complaints of dust are received from the Owner's representative and others.

.9 Obtain approval from authorities having jurisdiction before employing chemicals for dust control measures.

.10 Haul dusty materials by covered vehicles. Transport wet materials in watertight vehicles. Keep public and private roads free of dust, mud and construction debris resulting from trucks employed on this Project.

3.4 NOISE AND VIBRATION CONTROL

.1 Control noise and vibration generated by Work. Respond immediately to complaints of noise and vibration received from public, authorities, or Consultant.

.2 These requirements are for the consideration of the public, occupants and employees. Requirements shall not be construed as cause for elimination or restriction of Contractor's working schedule, claims for delay of work nor additional costs.

3.5 COLD WEATHER WORKING

.1 Contract Price to include for the provisions of temporary heating, temporary shelters and all other necessary cold weather measures to enable all trades to proceed without delay regardless of weather.

3.6 SNOW REMOVAL

.1 Be responsible to keep access road and circulation paths accessible during snowfall. Remove snow as necessary to prevent interruption to work in progress.

3.7 PEST CONTROL

.1 Provide rodent control and other pest control programs during the Work in accordance with the requirements of authorities having jurisdiction.

3.8 FIRES

.1 Open burning fires on-site will not be permitted.

3.9 FIRST AID SERVICES

.1 Provide and maintain First Aid services as required by the authorities having jurisdiction, the Workplace Safety and Insurance Board (WSIB) and Union Agreements.

3.10 ENVIRONMENTAL / POLLUTION CONTROL / SITE CLEANING

.1 Prevent the escape of untreated effluent, be it liquid or gaseous substance or any liquid or solid wastes, being objectionable or detrimental to adjoining areas of the construction site.

.2 Burning or burying of rubbish, waste, and the like is not permitted on construction site.

.3 Only fires for heating bitumen and temporary heaters as specified are permitted on-site.

.4 Take care to prevent staining or smoke damage to structure or materials. Replace stained or damaged work.

.5 Make every effort to provide environmental protection, take precautionary measures to prevent excessive noise, sounds, vibrations, dust, air pollution, smoke, etc., which may become objectionable to people occupying adjacent areas.

.6 Keep building site clean and free or unsightly collection of waste materials and debris. Provide for temporary storage and collection of waste materials and dispose to local authorities having jurisdiction recommendations at intervals to maintain a clean site condition.

.7 Confine apparatus, the storage of materials and the operations of workers to the Site. Do not unreasonably encumber the premises with construction materials.

3.11 TEMPORARY DRAINAGE AND DEWATERING

.1 The Work includes the removal of collected groundwater and surface water accumulating from precipitation and groundwater infiltration throughout the course of the Work until date of Substantial Performance of the Work.

.2 Keep drainage lines and gutters open. No flow of water shall be directed across or over pavements except through pipes or properly constructed troughs. Keep

portions of the Work properly and efficiently drained during construction and until completion. Be responsible for disturbances, dirt and damage which may be caused by or result from water backing up or flowing over, though, from or along any part of the Work, or due to operations which may cause water to flow elsewhere.

.3 Keep trenches and other excavations free of water. Remove water in a manner that will prevent loss of soil and maintain the stability of existing soils.

.4 Dispose of such water in a manner that will not be hazardous to public health and safety, private property, or to the Work.

.5 Drainage of trenches or other excavation through storm drainage pipe will be allowed only with the express permission of the authority having jurisdiction.

.6 When drainage is permitted in writing to be directed to existing catch basins, regularly and at Substantial Performance of the Work inspect such catch basins and remove accumulated debris and sediment.

END OF SECTION

1 General

1.1 INSTALLATION AND REMOVAL

.1 Provide temporary barriers and enclosures, safety and security controls, in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.2 PERMITS

.1 Arrange and pay for necessary permits for proper execution and completion of the work of this Section.

1.3 SUBMITTALS

.1 Shop Drawings:
- .1 Submit shop drawings for temporary barriers and enclosures in accordance with Section 01 33 00.
- .2 Clearly indicate details of construction, signage, profiles, jointing, fastening and other related details.

1.4 ACCESS TO SITE

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

1.5 PUBLIC TRAFFIC FLOW

.1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect the public.

1.6 FIRE ROUTES

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

1.7 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

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

.2 Be responsible for damage incurred.

1.8 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with Consultant locations and installation schedule three days prior to installation.

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

1.9 DESIGN AND SAFETY REQUIREMENTS FOR TEMPORARY WORK

.1 Be responsible for design, erection, operation, maintenance and removal of temporary structural and other temporary facilities, barriers, and enclosures.

.2 Engage and pay for registered professional engineering personnel skilled in the appropriate disciplines to perform these functions where required by law or by the Contract Documents; and in cases where such temporary facilities and their method of construction are of such a nature that professional engineering skill is required to produce safe and satisfactory results.

.3 Engage and pay for Professional Engineer(s) registered in Place of the Work to design and supervise construction and maintenance of temporary barriers and enclosures, covered ways, protective canopies and Project sign(s). Designs provided by Consultant or Owner, if any, for such work cover general appearance only.

2 Products

2.1 TEMPORARY FENCED ENCLOSURE MATERIALS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Plywood Hoarding:
- .1 Provide rough hardware required for the work of this Section.
- .2 Framing lumber and posts: Unless otherwise specified or indicated, NLGA No. 2 Construction SPF.
- .3 Reused material may be used.
- .4 Dimensions as follows, unless otherwise indicated or required by authorities having jurisdiction:
  - .1 Vertical posts: 89mm x 89mm (3-1/2" x 3-1/2").
  - .2 Horizontal rails: 39mm x 89mm (1-1/2" x 3-1/2").
  - .3 Hoarding: Plywood, 1220mm x 2440mm x 13mm thick (4' x 8' x 1/2"), sheathing grade conforming to CSA 0141.
  - .4 Reused material may be used.
  - .5 Hoarding to be painted in accordance with Section 09 90 00. Colour: From paint manufacturer’s standard white colour, to be approved by the Owner.

.3 Chain Link Hoarding:
- .1 Fence fabric: 3.75mm diameter (No. 9 gauge) steel wire woven in a 50mm (2") mesh, hot dipped galvanized after weaving and knuckled finish top and bottom selvage edges.
- .2 Galvanized fabric to have a minimum zinc application of 490g/m² of surface area.
- .3 Posts: CLFMI (Chain Link Fence Manufacturer Institute) Type 1, standard buttwelded Schedule 40, ASTM F1083 standard weight, galvanized pipe.
- .4 Provide prefabricated panelized chain link and post galvanized metal hoarding system.

.4 Signage: Provide suitable sized notice signs at entrance to the Place of the Work with contrasting text "RESTRICTED ACCESS - CONSTRUCTION SITE" complete with the name of Contractor.

2.2 GUARD RAILS AND BARRICADES MATERIALS

.1 Guard rails and barricades materials to be in accordance with authorities having jurisdiction.

3 Execution

3.1 HOARDING FABRICATION AND INSTALLATION

.1 Provide hoarding in accordance with approved schedule prior to start of work.

.2 Erect framing members and install hoarding panels at the perimeter of the Place of the Work as indicated or required by authorities having jurisdiction to fully enclose the Place of the Work and as follows, unless otherwise indicated or required by authorities having jurisdiction:

- .1 Height of hoarding: 2440mm (8') minimum, unless otherwise indicated, above grade at any point.
- .2 Vertical posts spaced 2440mm (8’) on centre, maximum.
- .3 Vertical posts: Set a minimum of 1220mm (4’) in the ground.
- .4 Horizontal rails securely nailed or screwed to vertical posts at top, bottom, and intermediate locations at 610mm (24") on centre.
- .5 Erect panels around objects as required.
- .6 Hoarding shall contain no opening more than 100mm (4") wide or less than 914mm (3') above the bottom of the fence except where required for access to and from the Place of the Work.
- .7 Provide no rails, other horizontal or diagonal bracing, attachments, or pattern of openings on the outside that would facilitate climbing.
- .8 At access openings: Provide gates that provide performance and safety at least equivalent to hoarding and contain wire mesh of sufficient openness to provide visibility for traffic entering or exiting the Place of the Work.

.3 Provide overhead protection hoarding where public access is required.

.4 Provide hoarding, access gates, access doors, in conformance with the Contract Documents and authorities having jurisdiction.

.5 Incorporate silt control fabric from 200mm (8”) below existing grade and attach to hoarding to provide silt control to requirements of authorities having jurisdiction and Owner.

.6 Mesh fencing: Erect metal posts at 3050mm (10') on centre maximum with tensar mesh.

.7 Hoarding hardware: Provide rough and finish hardware as required.

3.2 GUARD RAILS AND BARRICADES

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

.2 Provide as required by governing authorities having jurisdiction.

3.3 WEATHER ENCLOSURES

.1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in walls and roofs.

.2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.

.3 Design enclosures to withstand wind pressure and snow loading.

3.4 DUST TIGHT SCREENS

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

END OF SECTION

1 General

1.1 GENERAL

.1 Products refer to materials, manufactured components and assemblies, fixtures and equipment incorporated in the work.

.2 Products for use in the Project and on which the Bid was based shall be in production at time of tender date, with a precise model and shop drawings available for viewing.

.3 Where alternative products are proposed, these products claimed by the Contractor as equivalent shall be comparable in construction, type, function, quality, performance, and, where applicable, in appearance. Where specified equivalents are used in the Stipulated Price for the work, they shall be subject to final approval.

.4 Incorporate products in the work in strict accordance with Manufacturers' directions, instructions and specifications, where reference is made to them, shall include full information on storing, handling, preparing, mixing, installing, erecting, applying, and other matters concerning the materials that are pertinent to their use and their relationship to materials with which they are incorporated.

.5 Products delivered to the Project site for incorporation in the work shall be considered the property of the Owner. Maintain protection and security of products stored on the site after payment has been made for them.

.6 Do not install permanently incorporated labels, trademarks and nameplates, in visible locations unless required for operating instructions or by authorities having jurisdiction.

1.2 PRODUCT HANDLING

.1 Manufacture, pack, ship, deliver and store products so that no damage occurs to structural qualities and finish appearance, nor in any other way detrimental to their function or appearance, or both.

.2 Ensure that products, while transported, stored or installed, are not exposed to an environment which would increase their moisture content beyond the maximum specified.

.3 Schedule early delivery of products to enable work to be executed without delay. Before delivery, arrange for receiving at site.

.4 Deliver and store products at site in accordance with Section 01 50 00 and where directed by the Owner.

.5 Brace work such as door frames, large window units and similar products to prevent distortion or breakage in handling.

.6 Deliver packaged products, and store until use, in original unopened wrapping or containers, with Manufacturer's seals and labels intact.

.7 Label packaged Products to describe contents, quantity and other information as specified.

.8 Label fire-rated Products to indicate approval of Underwriters' Laboratories.

.9 Product handling requirements may be repeated, and additional requirements specified, in other Sections.

1.3 STORAGE AND PROTECTION

.1 Store Products on-site with secure protection against all harmful environmental conditions. Prevent damage, adulteration, staining and soiling of materials while stored.

.2 Protect prefinished metal surfaces by protective coatings or wrappings until time of final cleanup specified in Section 01 77 19. Protection shall be easily removable under work of Section 01 77 19 without damage to finishes.

.3 Store manufactured Products in accordance with Manufacturers' instructions.

.4 Store steel, lumber, masonry units, and similar Products on platforms raised clear of ground.

.5 Store finished Products and woodwork under cover at all times.

.6 Do not store Products at locations or in such a manner that they damage previously completed work.

.7 Storage and special protection requirements may be repeated, and additional requirements specified, in other Sections.

1.4 SCHEDULING OF PRODUCT DELIVERY

.1 Verify that Products supplied by all Sections are ordered from Suppliers in sufficient time to ensure delivery for incorporation in the work within the time limits established by approved construction schedule.

.2 Obtain confirmed delivery dates from product Suppliers.

.3 Immediately inform the Consultant should Supplier's confirmation of delivery dates indicate that Project completion may be delayed.

.4 Submit copies of purchase orders and confirmations of delivery dates for Products as may be requested.

.5 A schedule of product delivery shall be established and reviewed at each job site meeting.

1.5 DEFECTIVE PRODUCTS AND WORK

.1 Products and work that are defective, not in accordance with the Specifications, or defaced or damaged through negligence of the Contractor, his employees or Sub-Contractors, or by fire, weather or any other cause will be rejected for incorporation in the work whether or not incorporated in the work.

.2 Remove rejected Products and work from the premises immediately.

.3 Replace rejected Products and work with no delay after rejection. Provide replacement Products and execute replacement work precisely as required by the Specifications for the defective work replaced. Previous inspection and payment shall not relieve the Contractor from the obligation of providing sound and satisfactory work in compliance with the Specifications.

.4 Testing and retesting of any part of the work as directed by the Owner, Consultant or Contractor to establish its conformance to the Contract Documents shall be performed at no addition to the Contract Price.

1.6 WORKERS, SUPPLIERS AND SUBCONTRACTORS

.1 Assign work only to workers, suppliers, and Sub-Contractors who have complete knowledge, not only of the conditions of the Specifications, but of jurisdictional requirements, and reference standards and specifications.

.2 Certified and qualified installers of a specific product line shall be used when called for in these Specifications.

2 Products

2.1 SPECIFIED PRODUCTS

.1 Products used for temporary facilities may have been previously used, providing they are sound in structural qualities.

.2 Specified Options: The Work is based on materials, Products and systems specified by manufacturer's catalogued trade names, references to standards, by prescriptive specifications and by performance specifications.

.1 Where only one Manufacturer's catalogued trade name is specified for a Product, the Product is single sourced and shall be supplied by the specified Manufacturer.

.2 Where more than one Manufacturer's catalogue trade name is specified for a Product, select the Product from any one of those Manufacturers specified in accordance with Section 01 25 16 and provide shop drawings in accordance with Section 01 33 00.

.3 When a Product is specified by reference to a standard, select any Product from any Manufacturer that meets or exceeds the requirements of the standard for Consultant’s review and provide shop drawings in accordance with Section 01 33 00.

.4 When a Product or system is specified by prescriptive or performance specifications, select any Product or system which meets or exceeds the requirements of the prescriptive or performance specifications for Consultant’s review and provide shop drawings in accordance with Section 01 33 00.

.5 The onus is on the Contractor to prove compliance with governing published standards, prescriptive specifications and with performance specifications.

.3 Products, materials, equipment and articles (referred to as Products throughout the Contract Documents) incorporated in the Work shall be new, not damaged or defective, and of the quality standards specified, for the purpose intended. If requested, furnish evidence as to type, source and quality of Products Provided.

.4 Where Contract Documents list alternative Products or alternative manufacturers, select as applicable, any one Product from any one manufacturer meeting performance of specifications for Consultant’s review and provide shop drawings in accordance with Section 01 33 00.

.5 Where Contract Documents require design of a Product or system, and minimum material requirements are specified, the design of such Product or system shall employ materials specified within applicable Section. Where secondary materials or components are not specified, augment with materials meeting applicable code limitations, and incorporating compatibility criteria with adjacent work.

.6 Defective Products will be rejected, regardless of previous reviews. Review of the Work by the Consultant or inspection and testing companies does not relieve the Contractor of the responsibility for executing the Work in accordance with the requirements of the Contract Documents but is a precaution against oversight or error. Remove and replace defective Products and be responsible for delays and expenses caused by rejection at no additional cost to the Owner.

.7 Should any dispute arise as to quality or fitness of Products, the decision rests strictly with Consultant based upon the requirements of the Contract Documents.

.8 Unless otherwise indicated in the Contract Documents, maintain uniformity of manufacturer for any like item, material, equipment or assembly for the duration of the Work.

.9 Products exposed in the finished work shall be uniform in colour, texture, range, and quality, and be from one production run or batch, unless otherwise indicated.

.10 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical, electrical, machinery or like rooms.

.11 Owner retains right to select from choices available within specified Products for colours, patterns, finishes or other options normally made available. Submit full range of Product options in accordance with Section 01 33 00 for such selection.

.12 Quality Control:

.1 Implement a system of quality control to ensure compliance with Contract Documents.

.2 Notify Consultant of defects in the Work or departures from intent of Contract Documents that may occur during construction. Consultant will recommend appropriate corrective action in accordance with requirements of the Contract.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in the Contract Documents, install or erect Products in accordance with Manufacturer's printed instructions. Do not rely on labels or enclosures supplied with Products. Obtain printed instructions directly from manufacturers.

.2 Notify Consultant in writing, of conflicts between the Contract Documents and Manufacturer's instructions.

.3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Consultant to require removal and re-installation at no additional cost to the Owner.

.4 Manufacturers' representatives shall have access to the Work at all times. Contractor shall render assistance and facilities for such access in order that the Manufacturers' representatives may properly perform their function.

3.2 GALVANIC/DISSIMILAR METAL CORROSION

.1 Insulate dissimilar metals from each other by suitable plastic strips, washers or sleeves to prevent galvanic corrosion where conductive liquid or electrolyte exists.

3.3 WORKMANSHIP

.1 General:
- .1 Execute the Work using workers experienced and skilled in the respective duties for which they are employed.

.2 Do not employ an unfit person or anyone unskilled in their required duties.

.3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with Consultant, whose decision is final.

.4 Upon request by the Consultant, submit proof, in the form of CCDC 11 - Contractor's Qualification Statement, of qualifications of Sub-Contractors to verify Sub-Contractor's qualifications and experience meet or exceed the requirements of the Contract Documents.
- .1 If, upon review of the Contractor's Qualification Statement, the Consultant determines that the Sub-Contractor does not meet the qualification requirements specified in the Contract Documents pertaining to the parts of the Work for which the Sub-Contractor has been retained, the Contractor shall replace the unqualified Sub-Contractor with a qualified Sub-Contractor, satisfactory to the Owner, at no additional cost to the Owner and at no increase in the Contract Time.
- .2 Coordination:
  - .1 Ensure cooperation of workers in layout of the Work. Maintain efficient and continuous supervision.
  - .2 Be responsible for coordination and placement of openings, sleeves and accessories.
- .3 Cutting and Remedial Work:
  - .1 Perform cutting and remedial work required to make parts of the Work come together. Coordinate the Work to ensure this requirement is maintained. Obtain permission from Consultant before commencing any cutting.
- .4 Fastenings:
  - .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
  - .2 Prevent electrolytic action and corrosion between dissimilar metals and materials.
- .5 Protection of work in progress:
  - .1 Take reasonable and necessary measures, including those required by authorities having jurisdiction, to provide protection.
  - .2 Adequately protect parts of the Work completed or in progress. Parts of the 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 additional cost to the Owner.

.3 Do not cut, drill or sleeve any load bearing structural member without written permission of Consultant, unless specifically indicated.

.4 Keep floors free of oils, grease or other materials likely to discolour them or affect bond of applied surfaces.

.5 Protect work of other Sub-Contractors from damage while doing subsequent work. Damaged work shall be made good by appropriate Sub-Contractors but at expense of those causing damage.

.6 Protect existing buildings, curbs, roads and lanes. If, during the Work, any buildings, curbs, roads or lanes are damaged, bear costs for repairs.

.6 Existing Utilities:

.1 When breaking into or connecting to existing services or utilities, execute the Work at times approved by Owner, with a minimum of disturbance to Owner's ongoing operations, the Work, and traffic.

.2 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in a manner approved by authority having jurisdiction and stake or otherwise record location of capped service.

.7 Operational requirements: Operable Products shall be provided fully operational and ready for intended use.

END OF SECTION

1 General

1.1 GENERAL – CLEANING AND WASTE MANAGEMENT

.1 Conduct work of this Section in accordance with general requirements of the Contract Documents.

.2 Conduct cleaning and disposal operations to comply with local ordinances and environmental protection legislation.

.3 Store volatile wastes in covered metal containers and remove from premises at end of each working day.

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

1.2 CLEANING DURING CONSTRUCTION

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

.2 Remove waste material and debris from the work areas and deposit in waste container at the end of each working day.

.3 Vacuum clean interior areas prior to start of finishing work. Maintain areas free of dust and other contaminants during finishing operations.

.4 The overall responsibility for project cleanliness rests with the Contractor irrespective of whether the clean-up and removal of debris are related to work performed by Sub-Contractors.

1.3 WASTE MANAGEMENT

.1 Audit, separate and dispose of construction waste generated by new construction or by demolition of existing structures in whole or in part, in accordance with local laws and ordinances in place of Work.

.2 Fires, and burning of rubbish or waste on-site is prohibited.

.3 Burying of rubbish or waste materials, except as specified herein, is prohibited.

.4 Disposal of waste or volatile materials such as mineral spirits, oil, gasoline or paint thinner into ground, waterways, or sewer systems is prohibited.

.5 Empty waste containers on a regular basis to prevent contamination of site and adjacent properties by wind-blown dust or debris.

1.4 FINAL CLEANING OPERATIONS

.1 Immediately following Date of Substantial Performance, and prior to Owner occupancy of the building or portion of the building affected by the Work, conduct full and complete final cleaning operations.

.2 Final cleaning operations shall be performed by an experienced professional cleaning company, possessing equipment and personnel sufficient to perform full building cleaning operations.

.3 Remove all surplus products, tools, construction machinery and equipment not required for the performance of remaining work, and thereafter remove any remaining materials, equipment, waste and debris.

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

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

.6 Cleaning operations shall include the removal of all stains, spots, scuff marks, dirt, dust, remaining labels, adhesives or other surface imperfections.

.7 Remove all paint spots or overspray from all affected surfaces.

.8 Clean and polish all glass and mirrors. Replace broken, scratched or disfigured glazing. Remove remaining Manufacturer's and safety "X" labels.

.9 Clean and polish all finished metal surfaces such as enamelled or stainless steel, chrome, aluminum, brass, and bronze.

.10 Clean and polish all vitreous surfaces such as plumbing fixtures, ceramic tile, porcelain enamel, or other such materials.

.11 Clean all ceramic tile surfaces in accordance with the Manufacturer's instructions and apply final coat of sealer where specified.

.12 Clean inside of all millwork and cabinetry.

.13 Vacuum, clean and dust behind grilles, louvres and screens.

.14 Seal and wax all resilient floor surfaces as specified, and as recommended by the Manufacturer.

.15 Steam clean all carpets immediately prior occupancy by Owner.

.16 Broom clean and spray wash all exterior paved surfaces affected by the Work.

.17 Remove dirt and other disfiguration from exterior surfaces affected by the Work.

.18 Clean all roofs, gutters, downspouts, areaways, drywells, and drainage systems affected by the Work.

.19 Clean all equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment.

2 Products - Not Used

3 Execution - Not Used

END OF SECTION

1 General

1.1 GENERAL INSTRUCTIONS

.1 The procedures for completing Contract and acceptance by the Owner shall be in accordance with the methods prescribed by Owner.

.2 Stages will be reviewed at the Contract start-up meeting to ensure that parties understand their responsibilities. Refer to Section 01 31 19 for procedures and requirements for Contract start-up meeting.

.3 Within 4 weeks of commencement of the Work, submit to the Consultant a list of closeout submittals required by the Contract Documents.

.4 Note that entities other than the Owner may be involved in the closeout procedures described herein, including attendance at any operation and/or maintenance training sessions required. The Owner will coordinate such attendance as required.

.5 Comply with recommended takeover procedures contained in OAA/OGCA Document No. 100, except as modified by Contract Documents.

1.2 FINAL CLEANING

.1 Co-ordinate final clean-up with the Owner's representatives and opening requirements.

.2 In addition to requirements for cleaning-up specified in the General Conditions of the Contract, and in Section 01 11 00, include in work final cleaning by skilled cleaning specialists on completion of construction.

.3 Remove temporary protections and make good defects before commencement of final cleaning.

.4 Replace glass and mirrors that have been broken, damaged and/or etched during construction, or which are otherwise defective.

.5 Remove dust, stains, paint spots, soil, grease, fingerprints, and accumulations of construction materials, interior and exterior to the building. Perform cleaning in accordance with installer's instructions for each material. Final cleaning shall include:

- .1 Washing of interior concrete floors.
- .2 Cleaning and polishing of:
  - .1 glass;
  - .2 mirrors,
  - .3 ceramic tiles, enamel and finish metals;
  - .4 washroom accessories.
- .3 Vacuum cleaning of ceilings, walls and floors.
- .4 Cleaning of glazed wall surfaces.
- .5 Cleaning of hardware, mechanical fixtures, lighting fixtures, cover plates, and equipment, including polishing of their finish metal, porcelain, vitreous, and glass components.
- .6 Removing of visible labels left on materials, components, and equipment.
- .7 Maintain cleaning until Owner has taken possession of building or portions thereof.

1.3 CLOSE-OUT SUBMITTALS

.1 Collect reviewed submittals, and assemble required closeout submittals executed by Sub-Contractors, Suppliers, and Manufacturers. Prior to submitting closeout submittals to the Consultant, undertake the following:

- .1 Review maintenance manual contents (operating, maintenance instructions, as built drawings, materials) for completeness.
- .2 Review in relation to Contract Price, Change Orders, Change Directives, holdbacks and other adjustments to the Contract Price.
- .3 Review inspection and testing reports to verify conformance to intent of Contract Documents and that changes, repairs or replacements have been completed.
- .4 Execute transition of performance bond and labour and materials payment bond to warranty period requirements.
- .5 Submit a final statement of accounting giving total adjusted Contract Price, previous payments, and monies remaining at time of application for completion of the Contract. Consultant will issue a final change order reflecting approved adjustments to Contract Price not previously made, if any.

.2 No later than then 10 working days prior to submitting request for Consultant's review to determine if Substantial Performance of the Work has been achieved, submit to the Consultant the closeout submittals specified in this Section, including, but not limited to, reviewed shop drawings, Product data sheets, samples, operating instructions, as-built records, and fully executed warranties and guarantees.

.3 For items of the Work delayed materially beyond date of Substantial Performance of the Work, provide updated closeout submittals within 10 working days after acceptance, listing date of acceptance as start of warranty period.

.4 Neither the Consultant's review to determine if Substantial Performance of the Work has been achieved, nor acceptance of the Work, will take place until receipt, by the Consultant, of acceptable copies of the closeout submittals required herein and by the Contract Documents.

.5 As-built records and operation and maintenance manuals, as indicated in Section 01 33 00.

.6 Maintenance materials:

- .1 Deliver to a location and at a time specified by the Owner, organize items in Owner's storage area as directed by the Owner, and as follows:
  - .1 Use unbroken cartons, or if not supplied in cartons, material shall be strongly packaged.
  - .2 Clearly mark cartons or packaging as to contents, project name, and Supplier.
  - .3 If applicable give colour and finish, room number or area where material is used.
- .2 Replace incorrect or damaged maintenance materials delivered to Owner, including damage through shipment.
- .3 Provide a typed inventory list of maintenance materials prior to Substantial Performance of the Work application. List all items, complete with quantities, and storage locations.

.4 Establish a master list identifying maintenance materials and maintain a log of when materials are turned over to Owner and signing authority for acceptance of materials on behalf of Owner. Master list and log shall be in a format acceptable to the Owner.

.7 Owner communication material:

.1 Deliver Owner communication material that was applied to hoarding and/or temporary barriers and enclosures during the Work. Salvage such material in accordance with Section 01 11 00.

1.4 SUBSTANTIAL PERFORMANCE OF THE WORK

.1 Deficiency review:

.1 Neither Owner nor Consultant will be responsible for preparation or issuance of extensive lists of deficiencies. Contractor assumes prime responsibility for ensuring that items shown and described in the Contract Documents are complete. Any reviews to approve the Certificate of Substantial Performance of the Work will be immediately cancelled if it becomes obvious to the Consultant that extensive deficiencies are outstanding.

.2 The Contractor shall conduct an inspection of the Work to identify deficiencies and defects, which shall be repaired. When the Contractor considers that the Work is substantially performed, the Contractor shall prepare and submit to the Consultant a comprehensive list of items to be completed or corrected and apply for a review of the Work by the Consultant to determine if Substantial Performance of the Work has been achieved.

.3 The Contractor's request described above shall include a statement by Contractor that the Work to be reviewed by Consultant for deficiencies is, to the best of the Contractor's knowledge, in compliance with Contract Documents, reviewed shop drawings, and samples, and that deficiencies and defects previously noted by Consultant have been repaired.

.4 No later than 15 working days after the receipt of the Contractor's request described above, but contingent upon the prior receipt, by the Consultant, of the closeout submittals in the manner and form specified in this Section, the Consultant and the Contractor will review the Work to identify any defects or deficiencies. If necessary, the Contractor shall tabulate a list of deficiencies to be corrected prior to Substantial Performance of the Work being certified by the Consultant.

.5 During review, the Consultant and the Contractor will decide which deficiencies or defects must be rectified before Substantial Performance of the Work can be certified, and which defects are to be treated as warranty items.

.6 Provide a schedule of planned deficiency review having regard to the foregoing.

.2 Certification of Substantial Performance of the Work:

.1 When the Consultant considers that the deficiencies and defects have been completed and that it appears that the requirements of the Contract Documents have been substantially performed, the Consultant shall issue

a certificate of Substantial Performance of the Work to the Contractor, stating the date of Substantial Performance of the Work.

.2 The Certificate of Substantial Performance of the Work shall be prepared in form required by Construction Lien Act.

.3 Final Inspection for completion of the Contract:

.1 Deficiencies and defects shall be made good before the Contractor submits a written request for final review of the Work and before the Contract is considered complete.

.2 When Contractor is satisfied that the Work is complete, and after the Contractor has reviewed the Work to verify its completion in accordance with the requirements of the Contract Documents, the Contractor shall submit a written request for a final review by the Consultant, who in turn will notify the Owner.

.3 If there are any deficiencies identified as a result of this review, they shall be listed by the Consultant and submitted to the Contractor. This list shall be recognized as the final deficiency list for purposes of acceptance of the Work under the Contract.

.4 Such deficiencies shall be corrected by a date mutually agreed upon between Consultant and the Contractor, unless a specific date is required by Contract, and a further review by the Consultant shall be called for by the Contractor following his own review to take place within 7 days from date of request.

.5 Contractor shall thereafter submit invoice for final payment.

.6 Money shall be withheld for deficiency work and will be released only when all deficiencies have been completed. No partial payment to be recognized until all work is completed.

.4 If the Contractor needs to return to the Place of the Work to complete deficiencies after the Owner has taken possession, the Contractor shall provide the Owner with a minimum of 1 week's prior notice of such requirement.

1.5 WARRANTY PERIOD

.1 Provide on-going review and attendance to call-back, maintenance and repair problems during the warranty periods.

.2 At the beginning of one month before start of warranty period in accordance with General Conditions or as amended by Supplementary Conditions, the Owner, Contractor and Consultant, along with key Sub-Contractors as designated, shall carry out a complete review of the built project to determine which deficiencies are to be rectified under the warranty.

.3 Contractor shall be responsible for timely written notification of Owner, and Consultant a minimum of 3 months prior to such end of warranty period inspection and any delay in such notification shall extend such warranty period until proper notification is received by Owner, and Consultant.

2 Products - Not Used

3 Execution - Not Used

END OF SECTION

1 General

1.1 SUBMISSION

.1 Prepare instructions, Drawings and data using personnel experienced in maintenance and operation of described products.

.2 Revise content of documents as required prior to final submittal.

.3 Pay costs of shipping.
- .1 As-Built Documents: To Consultant's business address.
- .2 Spare Parts, Maintenance Materials, and Special Tools: To site.

.4 The amount of as built documents and operational and maintenance manuals is valued at 0.5% of the Contract Price for the purposes of determining Substantial Performance.

1.2 AS-BUILT DOCUMENTS

.1 Obtain from the Consultant and pay cost for one copy of Specifications and one set of white prints of the Contract Drawings at the commencement of Work, and, prior to the date of Substantial Performance, an extra set of white prints of Contract Drawings, for as-built purposes.

.2 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.3 As Work progresses, clearly mark in a neat and legible form with red ink on Specifications and drawing white prints all significant changes and deviations from the Contract Drawings and Specifications caused by site conditions, Supplemental Instructions and Change Orders.
- .1 Changes and deviations marked on as-built record drawings and Specifications by reference to Supplemental Instructions, Change Orders and other documents are not acceptable.

.4 Record the following changes and deviations on drawing white prints:
- .1 Depths of various elements of foundation in relationship to the first-floor level.
- .2 Field changes of dimensions.
- .3 Changes made by Addenda and change orders.
- .4 Details not on original Contract Drawings.
- .5 Other significant deviations and changes which are concealed in construction and cannot be identified by visual inspection.

.5 Show actual locations of the following on drawing white prints:
- .1 Access doors and panels.
- .2 Inverts of services at key points within the building, at points where entering and leaving the building, and at the property lines. Dimension services in relation to the structure and building grid lines.
- .3 Measured horizontal and vertical locations of site utilities and appurtenances, referenced to permanent surface improvements.
- .4 Ductwork, piping, conduit, mechanical and electrical equipment and associated work.

.5 Concealed piping, conduit and equipment, including such items provided for future use.

.6 Record the following information on the Specifications.
- .1 Manufacturer, trade name, and catalogue number of each product actually installed particularly optional items and substitute items.
- .2 Changes made by Addenda and change orders.
- .3 Accepted substitutions and alternatives.
- .4 Other approved changes and deviations to items specified.

.7 Have white prints and specifications available for review at all times.

.8 Final As Built Drawings: Prior to the date of Substantial Performance, allowing for Consultant's review, clearly, neatly and accurately transfer information from the marked-up drawing white prints to a set of clean white prints.
- .1 Print lettering and numbers in size to match original.
- .2 Lines may be drawn free hand, provided they are neat and accurate. Add "AS-BUILT RECORD" at each drawing title block. Should extensive changes and deviations to a Drawing make the information illegible, re-draft the changed areas as required.
- .3 Submit drawing white prints made containing as-built record information for Consultant's review. Correct as directed by Consultant.
- .4 Submit finalized as-built record drawing transparencies and as-built record Specifications to the Consultant 2 weeks prior to application for Certificate of Substantial Performance.

1.3 OPERATING AND MAINTENANCE MANUAL

.1 6 weeks prior to application for Certificate of Substantial Performance of the Work, submit to the Consultant, three final copies of operating and maintenance manuals in English.

.2 Organize data in the form of an instructional manual.

.3 Binders: vinyl, hard covered, 3 D ring, loose leaf 219mm x 279mm (8-1/2"x 11") with spine and face pockets.

.4 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

.5 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.6 Table of Contents, each binder: Provide title of project;
- .1 date of submission; names,
- .2 addresses, and telephone numbers of Consultant and Contractor with name of responsible parties;
- .3 schedule of products and systems, indexed to content of volume.

.7 Arrange content by systems, under Section numbers and sequence of Table of Contents.

.8 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.9 Text: Manufacturer's printed data, or typewritten data.

.10 For each product or system: List names, addresses and telephone numbers of Sub-Contractors and Suppliers, including local source of supplies and replacement parts.

.11 Product Data and Shop Drawings: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.12 Other Documents: Maintain manufacturer's certifications, inspection certifications, field test records, survey plans, required by individual Specifications Sections.

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

.1 Provide 1:1 scaled CAD files in dwg format or 1:1 scaled Revit files in rvt format on CD.

.14 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.

.1 Include installed colour coded wiring diagrams.

.3 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.

.4 Maintenance Requirements: Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.5 Provide servicing and lubrication schedule, and list of lubricants required.

.6 Include manufacturer's printed operation and maintenance instructions.

.7 Include sequence of operation by controls manufacturer.

.8 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.9 Provide installed control diagrams by controls manufacturer.

.10 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

.11 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.12 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.13 Additional requirements: As specified in individual specification sections.

.15 Materials and Finishes

.1 Building Products, Applied Materials, and Finishes: Include product data, with catalogue number, size, composition, and colour and texture designations.

.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.

1.4 STORAGE, HANDLING AND PROTECTION

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

.5 Remove and replace damaged products at own expense and to satisfaction of Consultant.

1.5 WARRANTIES AND BONDS

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.2 List Sub-Contractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by Sub-Contractors, 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 notarized.

.6 Co-execute submittals when required.

.7 Retain warranties and bonds until time specified for submittal.

2 Products

2.1 MATERIALS

.1 Provide new spare parts, maintenance materials and special tools, undamaged or defective, and of same quality and manufacture as products provided in the Work.

.2 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.3 If requested, furnish evidence as to type, source and quality of products provided.

2.2 SPARE PARTS AND MAINTENANCE MATERIALS

.1 Provide spare parts, maintenance and extra materials in quantities specified in individual Specification Sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to site; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Operating and Maintenance Manuals.

.5 Obtain receipt for delivered products and submit prior to final payment.

2.3 SPECIAL TOOLS

.1 Provide special tools, in quantities specified in individual Specification Section.

.2 Provide items with tags identifying their associated function and equipment.

.3 Deliver to site; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Operating and Maintenance Manuals.

3 Execution

3.1 TAKEOVER PROCEDURES

.1 Conform to OAA/OGCA Document No.100 for takeover procedures, subject to amendments by this Section.

END OF SECTION

WARRANTIES

1 General

1.1 WARRANTIES

.1 Warranties shall be in accordance with the General Conditions, as amended, and as follows:

- .1 Warranties shall commence at the start date of warranty period in accordance with the General Conditions, except where amended by Supplementary Conditions.
- .2 Submit warranties for applicable items, signed by the applicable company responsible for each warranty.
- .3 Submit warranties on form approved by Owner including, but not limited to, the following information:
  - .1 Name and address of Project.
  - .2 Warranty commencement date.
  - .3 Duration of warranty.
  - .4 Clear indication of what is being warranted and what remedial action will be taken under warranty.
  - .5 Authorized signature and seal of company providing each warranty.
- .4 Owner shall be named in manufacturer's Product warranties. Submit on relevant Product manufacturer's standard warranty or guarantee form.

2 Products - Not Used

3 Execution - Not Used

END OF SECTION

1 General

1.1 DESCRIPTION

.1 Demonstrate operation and maintenance of equipment and systems to Owner's personnel four weeks prior to date of Substantial Performance.

.2 Owner will provide list of personnel to receive instructions and will coordinate their attendance at agreed-upon times.

1.2 QUALITY ASSURANCE

.1 Instructor Qualifications: Factory authorized service representative, experienced in operation and maintenance procedures and training.

.2 Pre-Instruction Meeting: Conduct meeting at Project site to review methods and procedures related to demonstration and training including, but not limited to, the following:

- .1 Inspect and discuss locations and other facilities required for instruction.
- .2 Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
- .3 Review required content of instruction.
- .4 For instruction that must occur outdoors, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.3 SUBMITTALS

.1 Instruction Program: Submit three copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

- .1 At completion of training, submit three complete training manuals for Owner's use.

.2 Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 COORDINATION

.1 Coordinate training schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

.2 Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

.3 Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Consultant.

1.5 CONDITIONS FOR DEMONSTRATIONS

.1 Equipment has been inspected and put into satisfactory operation.

.2 Testing, adjusting, balancing and commissioning have been performed and equipment and systems are fully operational.

2 Products

2.1 INSTRUCTION PROGRAM

.1 Program Structure: Develop an instruction program that includes individual training modules for all systems and equipment not part of a system, including and not limited to:
- .1 Electrically operated equipment.
- .2 HVAC systems.
- .3 HVAC instrumentation and controls.
- .4 Electrical service and distribution.
- .5 Lighting equipment and controls.
- .6 Communication systems.

.2 Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following, as applicable:
- .1 Operational Requirements and Criteria:
  - .1 System, subsystem, and equipment descriptions.
  - .2 Performance and design criteria if Contractor has delegated design responsibility.
  - .3 Operating standards.
  - .4 Regulatory requirements.
  - .5 Equipment function.
  - .6 Operating characteristics.
  - .7 Limiting conditions.
  - .8 Performance curves.
- .2 Emergencies:
  - .1 Instructions on meaning of warnings, trouble indications, and error messages.
  - .2 Instructions on stopping.
  - .3 Shutdown instructions for each type of emergency.
- .3 Operations:
  - .1 Startup procedures.
  - .2 Equipment or system break-in procedures.
  - .3 Routine and normal operating instructions.
  - .4 Operating instructions for conditions outside of normal operating limits.
  - .5 Regulation and control procedures.
  - .6 Control sequences.
  - .7 Safety procedures.
  - .8 Normal shutdown instructions.
  - .9 Operating procedures for system, subsystem, or equipment failure.
  - .10 Seasonal and weekend operating instructions.
  - .11 Required sequences for electric or electronic systems.

.4 Adjustments:
- .1 Alignments.
- .2 Checking adjustments.
- .3 Noise and vibration adjustments.
- .4 Economy and efficiency adjustments.

.5 Troubleshooting:
- .1 Diagnostic instructions.
- .2 Test and inspection procedures.

.6 Maintenance:
- .1 Inspection procedures.
- .2 Types of cleaning agents to be used and methods of cleaning.
- .3 List of cleaning agents and methods of cleaning detrimental to product.
- .4 Procedures for preventive maintenance.
- .5 Procedures for routine maintenance.
- .6 Instruction on use of special tools.

.7 Repairs:
- .1 Diagnosis instructions.
- .2 Repair instructions.
- .3 Disassembly; component removal, repair, and replacement; and reassembly instructions.
- .4 Instructions for identifying parts and components.
- .5 Review of spare parts needed for operation and maintenance.

3 Execution

3.1 PREPARATION

.1 Verify that conditions for demonstration and instructions comply with requirements.

.2 Verify that designated personnel are present.

3.2 DEMONSTRATION AND TRAINING

.1 Delivery demonstration and training of each item of equipment at scheduled times, at the designated location.

.2 Instruct Owner’s personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

.3 Review contents of manual in detail to explain all aspects of operation and maintenance.

.4 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

3.3 EVALUATION AND CLEANUP

.1 Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written performance-based test.

.2 Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.4 TIME ALLOCATION

.1 Ensure amount of time required for demonstration and training of each item of equipment or system as follows:

.1 HVAC System: 12 hours.
.2 Control System: 12 hours.
.3 Plumbing System: 4 hours.
.4 Communication System: 4 hours.
.5 Electrical System: 4 hours.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Review Drawings, site conditions, and other Specification Sections to ascertain the extent and nature of work of this Section.

.2 The Work of this Section includes the following:
- .1 Demolish and removal of portions of existing walls, ceilings, finishes, millwork, electrical and mechanical components, as indicated on Drawings.
- .2 Disconnect/cap existing service in areas of demolition.
- .3 Dispose of demolished materials except where required to be salvaged or reused.
- .4 Refer to demolition notes indicated on Drawings.

.3 Drawings contain details that suggest directions for solving some of the major demolition and removal requirements for this project; Contractor is required to develop these details further by submitting a demolition plan prepared by a Professional Engineer employed by the Contractor.

1.3 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 American National Standards Institute (ANSI):
- .1 ANSI A10.8, Scaffolding Safety Requirements

.3 Canadian Standards Association (CSA):
- .1 CSA S350, Code of Practice for Safety in Demolition of Structures.

.4 National Fire Protection Association (NFPA):
- .1 NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations

.5 Ontario Building Code (OBC).

.6 Provincial Legislation:
- .1 Legislation specific to Authority Having Jurisdiction for work governed by this Section.

1.4 DEFINITIONS

.1 Demolish: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

.2 Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

.3 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

.4 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed, removed and salvaged, or removed and reinstalled.

.5 Hazardous Material: Product, substance, or organism that is used for its original purpose; and that is either dangerous goods or a material that may cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.

1.5 EXAMINATION

.1 Visit and examine the site and note all characteristics and irregularities affecting Work of this Section. Submit a pre-demolition inspection report. Ensure the Owner of premises being inspected is represented at inspection.

.2 Where appropriate prepare a photographic or video record of existing conditions, particularly of existing work scheduled to remain.

.3 Where applicable, examine adjacent tenancies not part of the scope of work. Determine extent of protection required to areas and related components not subject to demolition.

.4 Refer to Section 02 81 16 and Appendix 1 – Fire Station #2 Designated Substances Survey – Aug.16, 2022, prepared by S2S Environmental Inc., attached to the Tender Documents. Stop work and notify the Consultant should other suspected hazardous materials are encountered during work of this Section.

1.6 SUBMITTALS

.1 Provide required information in accordance with Section 01 33 00.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Prepare schedule in conjunction with overall project schedule and outline proposed methods in writing. Obtain approval before commencing demolition work, and indicate the following:

.1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity

.2 Interruption of utility services

.3 Coordination for shutoff, capping, and continuation of utility services

.3 Submit drawings for demolition of structural elements bearing the seal of a Professional Engineer licensed to design structures and registered in the Province of Ontario.

1.7 QUALITY ASSURANCE

.1 Conform to requirements of all authorities having jurisdiction.

.2 Comply with applicable requirements of CSA S350, Code of Practice for Safety in Demolition of Structures.

.3 Work of this Contract shall be executed by an approved company having a minimum of 5 years continuous experience and able to deploy adequate equipment and skilled personnel to complete work expediently in an efficient and orderly manner.

.4 Perform cutting and coring, where applicable, by a firm specializing in this type of work, able to produce evidence of successful completion of similar work over a period of at least 5 years immediately prior to date of Contract.

.5 Apply for, secure, arrange and pay for all permits, notices and inspections necessary for proper execution and completion of work in this Section.

.6 Professional Engineer Qualifications: Procure the services of a Professional Engineer who is experienced in providing relevant engineering services to perform the following:

.1 Review portions of the Work requiring structural performance, prepare plan of action, engineer temporary shoring and bracing, and Provide site administration and inspection for work of this Section.

1.8 PROTECTION

.1 Prevent movement or settlement of adjacent work. Provide and place bracing or shoring and be responsible for safety and support of such work. Be liable for any such movement or settlement, and any damage or injury caused.

.2 Cease operations and notify Consultant if safety of any adjacent work or structure appears to be endangered. Take all precautions to support the structure. Do not resume operations until reviewed with the Consultant.

.3 Prevailing weather conditions and weather forecasts shall be considered. Demolition work shall not proceed when weather conditions constitute a hazard to the workers and site.

.4 Prevent damage of surrounding vegetation near Work area. Install tree protection barriers to trees that are scheduled to remain and are affected by the Work.

.5 Prevent debris from blocking surface drainage inlets and mechanical and electrical systems which remain in operation.

.6 Temporarily suspended work that is without continuous supervision shall be closed to prevent entrance of unauthorized persons.

1.9 REMAINING AND ADJACENT STRUCTURES

.1 Do not interfere with, encumber, endanger or create nuisance, from any cause due to demolition work, to public property or any adjacent attached and/or detached structures in possession of Owner or others, which are to remain, whether occupied or unoccupied during this work.

.2 Make good damage to such structures resulting from work under this Section at no cost to Owner. Make good adjacent building surfaces damaged by work of this Section.

1.10 PROTECTION OF SERVICES AND STRUCTURES

.1 Take necessary precautions to guard against movement, settlement or collapse of existing adjacent utility services, public property and/or structures, whether to remain or not. If these or other unforeseen conditions develop, take immediate emergency measures, report to Consultant, confirm in writing, and await instructions before proceeding with any further related demolition work.

.2 Prior to saw cutting or core drilling of existing concrete slabs, use ground penetrating radar (GPR) to detect utilities and structural reinforcing. Concrete X-Rays can be used when access to both sides of concrete slab is accessible for placement of required x-ray film.

1.11 EXISTING SERVICES

.1 Prior to start of demolition disconnect all electrical and telephone service lines in the areas to be demolished. Post warning signs on all electrical lines and equipment which must remain energized to serve other areas during period of demolition. Disconnect electrical and telephone service lines in demolition areas to the requirements of local authority having jurisdiction.

.2 In each case, notify the affected utility company in advance and obtain approval where required before commencing with the work on main services.

.3 Arrange with utility companies for locating of such services and for disconnection of existing services owned by utility companies and which will be disconnected by said utility companies, provided such services do not interfere with adjacent tenancy operators.

.4 Remove sewer and water lines where required within existing building as deemed necessary, and cap to prevent leakage, in accordance with authorities having jurisdiction.

.5 Existing services are to be maintained where required for normal tenant operation during regular hours of operation and/or as deemed necessary by Owner.

1.12 EXISTING WARRANTIES

.1 Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

2 Products

2.1 DEBRIS, SALVAGED MATERIAL AND EQUIPMENT DISPOSAL

.1 All materials and or equipment salvaged from demolition work becomes property of demolition Contractor unless designated otherwise.

.2 At no cost to Owner repair or replace material and/or equipment scheduled to remain which is damaged by demolition work. Do not sell any salvaged material or equipment directly from project site.

.3 Remove waste debris continually and entirely from project site during demolition work. Do not load vehicles transporting such debris beyond their safe capacity or in a manner which might cause spillage on public or private property. If spillage does occur, clean up immediately to prevent traffic hazards or nuisance.

2.2 PROTECTION

.1 Temporary Protection:

.1 Erect temporary hoarding protection, as indicated in Section 01 56 00, to enclose openings in exterior walls, and/or provide security to partially occupied interior spaces.

.2 Erect temporary dust screens, as indicated in Section 01 50 00, to prevent dust and debris to enter areas of the building which are not scheduled for demolition. Remove temporary dust screens when no longer required.

2.3 REPAIR MATERIALS

.1 Use repair materials identical to existing materials:

.1 If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

.2 Use a material whose installed performance equals or surpasses that of existing material.

.3 Comply with material and installation requirements specified in individual Specification Sections.

.2 Floor Patching and Levelling Compounds: Cement based, trowelable, self-levelling compounds compatible with specified floor finishes; gypsum based products are not acceptable for work of this Section.

.3 Concrete Unit Masonry: To match existing adjacent concrete unit masonry. Refer to Section 04 20 00.

.4 Brick: Install brick and mortar, cut and trimmed to accommodate new opening as shown on Drawings. Match brick and mortar to existing adjacent materials as approved by the Consultant. Provide ties and accessories as required to complete the installation. Maintain continuity of thermal, vapour, and air barriers of existing assembly. Install rigid insulation of matching type as existing. Refer to Section 04 20 00.

.5 Gypsum Board Patching Compounds: Joint compound to ASTM C475, bedding and finishing types thinned to provide skim coat consistency to patch and prepare existing gypsum board walls ready for new finishes in accordance with Section 09 21 16.

.6 Fireproofing: Patch and repair all fireproofing damaged during demolition of adjacent surfaces with compatible fireproofing materials. Provide test reports from fireproofing manufacturer warranting installation, adhesion and compatibility between existing and new fireproofing materials.

.7 Soil and Sod: Repair soil and sod damaged during Work and from removal of existing transformer with the following:

.1 Number One Turf Grass Nursery Sod: Sod that has been especially sown and cultivated in nursery fields as turf grass crop.

.2 Topsoil for seeded/sodded areas: Mixture of particulates, micro-organisms and organic matter which provides suitable medium for supporting intended plant growth. Soil texture based on The Canadian System of Soil Classification, to consist of 20 to 70% sand, minimum 7% clay and contain 2% to 10% organic matter by weight. Topsoil to contain no toxic elements or growth inhibiting materials.

.8 Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to Section 07 01 53.

2.4 EXISTING MATERIALS

.1 Items to be salvaged, retained for re-use in new construction, and reinstalled by Contractor include, but are not limited to the following:

.1 Lockers.

.2 Appliances and equipment, as indicated on Drawings, including but not limited to extractor (industrial washing machine), dryer, dishwasher.

.3 Gym equipment.

.4 Lighting fixtures.

.2 Items to be salvaged and returned to Owner for re-use include, but are not limited to the following:

.1 Refrigerator on the first floor, as indicated on Drawings.

.2 Recycling and compost bin.

.3 Tables and chairs.

.3 Confirm with Consultant any materials that appear to be in re-usable condition prior to disposal.

.4 Confirm with Consultant any materials scheduled for re-use that are not in re-usable condition prior to installation.

3 Execution

3.1 GENERAL

.1 Exercise caution in dismantling, disconnecting of work adjacent to existing work designated to remain.

.2 Carry out demolition in a manner to cause as little inconvenience to the adjacent properties as possible.

.3 Carry out demolition in an orderly and careful manner.

.4 Demolition by explosives is not permitted.

.5 Selling or burning of materials on site is not permitted.

.6 Sprinkle exterior debris with water to prevent dust. Do not cause flooding, contaminated run-off or icing. Do not allow waste material, rubbish, and windblown debris to reach and contaminate adjacent properties.

.7 Lower waste materials in a controlled manner; do not drop or throw materials from heights.

.8 At end of each day's work, leave in safe condition so that no part is in danger of toppling or falling.

3.2 SAFETY AND SECURITY

.1 Maintain security of the building at all times during demolition work.

.2 Provide and maintain fire prevention equipment and alarms accessible during demolition.

3.3 ACCESS ROUTES

.1 Restrict operations to designated access routes.

.2 Do not obstruct roads, parking lots, sidewalks, hydrants and the like.

3.4 SELECTIVE DEMOLITION

.1 Provide necessary shoring and supports to assure safety of structure prior to cutting and coring.

.2 Where practical, sawcut and remove material as required.

.3 Where saw-cutting is not appropriate, use suitable hand tools.

.4 Demolish, cut-out and remove from site all other work noted on Drawings or required to permit new construction.

.5 Do not allow water to accumulate or flow beyond work area. Provide receptacles and mop-up as work proceeds.

.6 Fill all openings in concrete block walls with concrete masonry units, coursing to match existing, prepare ready to receive new finishes to match existing.

.1 Provide bond beams in new openings cut into existing concrete masonry unit walls.

.2 Provide finished end masonry units to patch and repair for new jamb sections in existing concrete masonry unit walls.

.7 Fill all openings in gypsum board walls with gypsum board and steel framing to match existing, skim coat to make wall smooth and even.

.8 Demolish existing flooring and wall finishes, and adhesive remnants as follows:

.1 Floor and wall substrate shall be smooth, free from ridges and depressions, and adhesive remnants that could telegraph through new flooring and wall finishes.

.9 Demolish completely all ceiling panels and grid as indicated. Salvage finishes on ceiling and bulkheads where indicated on Drawings.

.10 Remove all wall coverings scheduled for demolition. Patch and repair wall surfaces with skim coat of gypsum board joint compound leaving wall surfaces smooth and even ready for new wall finishes.

.11 Patch and repair all walls, floor and ceilings damaged during demolition with material matching adjacent walls, prepare ready for new finishes.

.1 Prepare existing surfaces schedule to receive new finish by grinding, filling, over-coating, stripping, washing, etching, shot blasting or other

chemical or mechanical means, as required to ensure satisfactory installation of new finish.

3.5 PATCHING AND REPAIRING

.1 Floors and Walls:

.1 Where walls or partitions that are demolished extend from one finished area into another, patch and repair floor and wall surfaces in the new space.

.2 Provide a level and smooth surface having uniform finish colour, texture, and appearance.

.3 Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform colour and appearance.

.4 Patch with durable seams that are as invisible as possible.

.5 Provide materials and comply with installation requirements specified in other Sections of these Specifications.

.6 Patch any existing areas adjoining / adjacent to new construction in good workmanship, filling and finishing gaps between finishes to allow new work to blend seamlessly with existing work.

.7 Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.

.8 Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

.2 Ceilings: Patch, or repair existing ceilings as necessary to provide an even-plane surface of uniform appearance.

.3 Exterior Walls: Where portions of exterior walls are indicated to be demolished, patch and repair exterior walls using similar wall construction techniques as adjacent wall construction. Ensure compatibility between insulation, air barrier and vapour retarder, providing continuous air and vapour control and wall R-Value between existing and new construction. Provide exterior and interior finish materials, matching existing adjacent materials, to provide an even-plane surface of uniform appearance.

.4 Soil and Sod: Repair soil and sod damaged during Work and from removal of existing transformer. Grade to eliminate rough spots and low areas and ensure positive drainage. Leave surfaces smooth, uniform and firm against deep foot printing. Soil management to meet requirements of authorities having jurisdiction and Environmental Protection Act.

3.6 EXCESSIVE DEMOLITION

.1 Where excessive demolition occurs, be responsible for cost of replacing such work.

.2 Consultant shall determine extent of such 'over-demolition' and method of rectification.

3.7 COMPLETION

.1 Leave project site as directed, reasonably clean and presentable, free from above grade debris, any salvaged material and/or equipment except those designated to remain.

.2 Maintain access to exits clean and free of obstruction during removal of debris.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Hazardous materials have been identified as being present in the building; abatement and removal form a part of the Work of the Project.

1.3 RELATED REQUIREMENTS

.1 Section 02 41 19.

.2 Appendix 1 – Fire Station #2 Designated Substances Survey – Aug.16, 2022.

1.4 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Environment Canada:
- .1 Canadian Environmental Protection Act (CEPA)
- .2 Export and Import of Hazardous Waste Regulations, including amendments

.3 Health Canada:
- .1 Safety Data Sheets (SDS)
- .2 Workplace Hazardous Materials Information System (WHMIS)

.4 Transport Canada:
- .1 Transportation of Dangerous Goods Act (TDG)
- .2 Transportation of Dangerous Goods Regulations, including amendments

1.5 DEFINITIONS

.1 Dangerous Goods: Product, substance, or organism that is specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.

.2 Hazardous Material: Product, substance, or organism that is used for its original purpose; and that is either dangerous goods or a material that may cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.

.3 Hazardous Waste: Any hazardous material that is no longer used for its original purpose and that is intended for recycling, treatment or disposal.

.4 Workplace Hazardous Materials Information System (WHMIS): Canada wide system designed to give employers and workers information about Hazardous Materials used in workplace. Under WHMIS, information on Hazardous Materials is provided on container labels, safety data sheets (SDS), and worker education programs. WHMIS is put into effect by combination of federal and provincial laws.

1.6 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Construction Meeting: Conduct a meeting at Project site, to confirm extent of Hazardous Materials abatement and removal to review Contractor's project requirements, site safety concerns and scheduling requirements and to establish procedures for the following:
- .1 Asbestos Abatement, Removal and Disposal
- .2 Lead Removal and Disposal
- .3 Mercury Removal and Disposal
- .4 Ozone Depleting Substances Removal and Disposal
- .5 Polychlorinated-Biphenyl Ballast Removal and Disposal
- .6 Other substances suspected to be present within the building or listed in Appendix 1 – Fire Station #2 Designated Substances Survey – Aug.16, 2022.

.2 Coordination: Coordinate Hazardous Materials work so that work of this Section adheres to criteria indicated in the Hazardous Materials Report prepared by a specialist consultant retained by the Owner and as referenced in Division 00 Documents.

1.7 EXAMINATION

.1 Visit and examine the site and note all characteristics and irregularities affecting Work of this Section. Submit a pre-demolition inspection report. Ensure the Owner of premises being inspected is represented at inspection.

.2 Where appropriate prepare a photographic or video record of existing conditions, particularly of existing work scheduled to remain.

.3 Where applicable, examine adjacent tenancies not part of the scope of work. Determine extent of protection required to areas and related components not subject to demolition.

1.8 QUALITY ASSURANCE

.1 Regulatory Requirements: Perform work of this Section in accordance with environmental, fire, health and safety acts, codes and regulations as established by the authority having jurisdiction.

.2 Qualifications: Provide proof of qualifications when requested by Consultant:
- .1 Abatement and Removal Personnel: Use Contractors, Sub-Contractors or personnel who have specific training and experience with the abatement and removal of Hazardous Materials identified as being present at the project site; train personnel in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.
- .2 Insurance: Use a hazardous materials abatement company that has adequate insurance for performing work of this Section.
- .3 Equipment: Use equipment, storage containers and other temporary facilities appropriate to the level of risk presented by the Hazardous Materials identified as being present at the project site and that are acceptable to the authority having jurisdiction.

1.9 SITE CONDITIONS

.1 Hazardous materials identified in the Hazardous Materials report and other related information referenced are for the Contractor's information only and does not represent a warranty by the Consultant of actual site conditions; use of this information is at Contractor's own risk.

.2 Visit site to become acquainted with site conditions before submitting Bids to derive an opinion on the results of the information presented by the Hazardous Materials Report and the extent of work required to complete the requirements of this Section.

.3 The Consultant and Owner recognize that conditions indicated in the Hazardous Materials Report actually encountered during construction may differ from the information presented in the Hazardous Materials Report; where this occurs, the changed conditions will be administered as a change in accordance with the Contract.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Storage and Handling Requirements: Store and handle Hazardous Materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines and as follows:

- .1 Store and handle flammable and combustible materials in accordance with current Fire Code requirements.
- .2 Store Hazardous Materials and wastes in closed and sealed containers.
- .3 Label containers of Hazardous Materials and wastes in accordance with WHMIS.
- .4 Store Hazardous Materials and wastes in containers compatible with that material or waste.
- .5 Segregate incompatible materials and wastes.
- .6 Ensure that different Hazardous Materials or hazardous wastes are not mixed.
- .7 Store Hazardous Materials and wastes in secure storage area with controlled access.
- .8 Maintain clear egress from storage area.
- .9 Store Hazardous Materials and wastes in location that will prevent them from spilling into environment.
- .10 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.
- .11 Maintain inventory of Hazardous Materials and wastes, including product name, quantity, and date when storage began.
- .12 Report spills or accidents immediately to Consultant and submit a written spill report within 24 hours of incident.

.2 Transportation: Transport Hazardous Materials and wastes in accordance with federal Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations and as follows:

- .1 Comply with federal Export and Import of Hazardous Waste Regulations where it is necessary to export hazardous waste to another country.
- .2 Comply with applicable federal, provincial and municipal laws and regulations for generators of hazardous waste.

.3 Use licensed carrier authorized by provincial authorities to accept subject material.

.4 Obtain written notice from intended hazardous waste treatment or disposal facility that it will accept material and that it is licensed to accept this material prior to shipping hazardous waste.

.5 Label containers with legible, visible safety marks as prescribed by federal and provincial regulations.

.6 Use trained personnel to handle, offer for transport, or transport dangerous goods.

.7 Provide photocopy of shipping documents and waste manifests to Consultant.

.8 Track receipt of completed manifest from consignee after shipping dangerous goods; provide a photocopy of completed manifest to Consultant.

.9 Report discharge, emission, or escape of Hazardous Materials immediately to Authority Having Jurisdiction and Consultant; take reasonable measures to control release.

2 Products

2.1 MATERIALS

.1 Provide all temporary facilities, equipment, containers and spill remediation kits required by authority having jurisdiction and as necessary to complete the work of this Section.

.2 Provide SDS in proximity to where materials are being stored; communicate this location to personnel who may have contact with hazardous waste materials.

3 Execution

3.1 DISPOSAL

.1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.

.2 Recycle hazardous wastes where there is approved, cost effective recycling process available.

.3 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.

.4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.

.5 Disposal of Hazardous Materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.

.6 Dispose of hazardous wastes in timely fashion in accordance with applicable provincial regulations.

.7 Take necessary precautions to avoid mixing clean and contaminated wastes.

.8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:

.1 Hazardous wastes recycled in manner constituting disposal.
.2 Hazardous waste burned for energy recovery.
.3 Lead acid battery recycling.
.4 Hazardous wastes with economically recoverable precious metals.
.5 Additional items identified during the course of the work.

.9 Sequence abatement and removal of Hazardous Materials with selective demolition work; complete removal of Hazardous Materials and make areas clean before actual start of demolition activities.

END OF SECTION

1 General

1.1 SUMMARY

.1 Supply all labour, materials, equipment, services and perform all operations required to complete concrete formwork and falsework installation.

1.2 RELATED REQUIREMENTS

.1 Section 03 20 00
.2 Section 03 30 00
.3 Section 07 92 00

1.3 REFERENCES

.1 Canadian Standards Association (CSA)
- .1 CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .2 CAN/CSA O86-09, Engineering Design in Wood
- .3 CSA O121-08, Douglas Fir Plywood.
- .4 CSA O151-09, Canadian Softwood Plywood.
- .5 CSA O153-M1980, Poplar Plywood.
- .6 CSA O325-07 (R2012), Construction Sheathing.
- .7 CSA O437 Series-93, Standards for OSB and Waferboard.
- .8 CSA S269.1-1975 (R2003), Falsework for Construction Purposes.
- .9 CAN/CSA-S269.3-M92 (R2013), Concrete Formwork.
- .10 CSA-S413-07, Parking Structures

.2 American Concrete Institute (ACI):
- .1 ACI 347-04, Guide to Formwork of Concrete.

.3 National Lumber Grades Authority (NLGA):
- .1 Standard Grading Rules for Canadian Lumber, 2010.

1.4 DEFINITION

.1 Architectural Concrete — Concrete that is exposed as an interior or exterior surface in the completed structure that contributes to the visual character of the completed structure.

1.5 DESIGN REQUIREMENTS

.1 Design formwork in accordance with CSA S269.1, CAN/CSA S269.3-M and CSA A23.1 Clause 6.5 – Formwork. For Architectural Concrete, provide formwork that conforms to the requirements of CSA A23.1 Clause 8.3.4 – Formwork for Special Architectural Finishes.

.2 Design and engineer falsework and formwork including shoring and bracing to resist loads due to wet concrete, forms, wind, dead loads, construction live loads and forces arising from use of equipment to place concrete without differential settlement between them and to ensure finished concrete within the tolerances required by CSA-A23.1/A23.2.

.3 Design forms for concrete exposed to view or to carry finish, with maximum deflection of 1/400th of span.

.4 When high range water reducer (superplasticizer) is used in concrete mix, design forms for full hydrostatic pressure.

.5 Make joints in forms watertight.

.6 Design formwork to meet variations from a reference system specified in CSA A23.1 Clause 6.4.6.

1.6 SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Shop Drawings:

.1 Indicate the method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1 for falsework drawings and comply with CAN/CSA S269.3-M for formwork drawings.

.2 Shop drawings shall indicate:

.1 Layout of panel joints, and tie hole pattern.

.2 Method of sealing form tie hole.

.3 Coordinate with details where shown on the Contract Drawings.

.3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.

.4 Indicate sequences of erection and removal of formwork/falsework.

.5 Include full details and locations of splices.

.6 Each shop drawing submission shall be stamped and signed by a qualified Professional Engineer licensed to practice in the Province of Ontario.

.3 Product Data:

.1 Submit the Manufacturer's Product data sheets including materials, allowable loading, installation, application and maintenance, and instructions for the applicable items listed:

.1 Proprietary scaffolding.

.2 Shoring beams.

.3 Lumber for formwork and falsework.

.4 Plywood for formwork and falsework.

.5 Tubular column forms.

.6 Form release agent.

.7 Form ties.

.8 Manufacturer's details and specifications for proprietary materials used in formwork liners and coatings.

.4 Submit one sample for each of the following items:

.1 Form ties.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

.4 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOCs.

2 Products

2.1 MATERIALS

.1 For concrete with special architectural features, use formwork materials in accordance with CSA A23.1/A23.2.

.2 Plywood: CSA O121, G1S; Douglas Fir plywood, sheets as large as practical, minimum 19mm thick, seven ply, exterior grade, waterproof glue, edges sealed with oil-based sealer.

.3 Prefabricated steel forms: CSA S136; Free of irregularities, dents, sags, rust, and materials that can discolour concrete finish.

.4 Steel forms: seamless, steel plates, internally treated with release material.

.5 Tubular column forms: Round, spirally wound laminated fibre forms free of dents and other irregularities, complete with seamless plastic liner, internally treated with form release agent.

.6 Form ties:
- .1 For concrete not designated 'Architectural Concrete', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25mm diameter in concrete surface.
- .2 For Architectural Concrete, use snap ties complete with plastic cones and light grey concrete plugs.
- .3 Wire ties shall not be permitted.

.7 Form release agent: Quick drying, sprayable, non-staining, non-toxic coating, compatible with paint and mortar, VOC compliant, containing compounds that react with free lime present in concrete forming water insoluble soaps, preventing concrete from sticking to forms.
- .1 Eucoslip VOX by The Euclid Chemical Company;
- .2 Clean Strip Ultra (J-3 VOC) by Dayton Superior Corp.;
- .3 Sealtight Duogard II by W.R. Meadows of Canada Ltd.;
- .4 Debond Form Coating by L&M Construction Chemicals Inc. Buffalo., N.Y.

.8 Chamfer strips: 20 x 20mm triangular fillets milled from clear, straight grain pine, surfaced each side, or extruded vinyl type, with or without nailing flange.

.9 Falsework materials: in accordance with CSA S269.1.

.10 Sealant: in accordance with Section 07 92 00.

3 Execution

3.1 FABRICATION AND ERECTION

.1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions are consistent with the Contract Drawings.

.2 Obtain approval from the Consultant for the use of earth forms framing openings not indicated on the Drawings.

.3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.

.4 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within the tolerances required by CSA-A23.1/A23.2.

.5 Do not place shores and mud sills on frozen ground.

.6 Provide Site drainage to prevent the washout of soil supporting mud sills and shores.

.7 Align form joints and make watertight. Keep form joints to minimum.

.8 Use 20mm chamfer strips on external corners and/or 20mm fillets at interior corners, joints, unless specified otherwise in the Contract Documents.

.9 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated on the Contract Drawings.

.10 Construct forms for Architectural Concrete, and place ties as indicated and/or as directed. Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.

.11 Build in anchors, sleeves, and other inserts required to accommodate work specified in other Sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.12 Clean formwork in accordance with CSA-A23.1/ A23.2, before placing concrete.

3.2 REMOVAL AND RE-SHORING

.1 Leave formwork in place for following minimum periods of time after placing concrete.

.1 4 Days for walls.

.2 7 Days for columns.

.3 Until concrete has reached 70% of its compressive strength and not before seven 7 Days for beams, slabs, decks and other structural members. Re-shore concrete with adequate shoring to standards specified for 14 additional Days.

.2 Provide all necessary re-shoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

.3 Space re-shoring in each principal direction at not more than 3,000mm apart.

.4 Re-shoring shall remain until concrete has reached its 28-Day designed compressive strength.

.5 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

3.3 CONSTRUCTION JOINTS

.1 Obtain approval from the Consultant for location and details of construction joints shown a minimum of 2 weeks prior to start formwork.

3.4 EXPANSION AND CONTROL JOINTS

.1 Construct expansion and control joints at the locations indicated and in accordance with the details shown on the Contract Drawings.

.2 Construct clean expansion joints free of foreign material, likely to impair the proper operation of the joint.

.3 Provide a non-extruding joint filler in expansion joints for the full area between adjacent concrete members. Anchor the filler material to one of the adjacent members or between concrete members and adjacent members of other materials.

END OF SECTION

1 General

1.1 SUMMARY

.1 Supply all labour, materials, equipment, fuel, services and perform all operations required to complete concrete reinforcing installation.

1.2 RELATED REQUIREMENTS

.1 Section 03 10 00
.2 Section 03 30 00

1.3 REFERENCES

.1 Canadian Standards Association (CSA):
  .1 CSA A23.1-09/A23.2-09, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
  .2 CAN/CSA A23.3-04, Design of Concrete Structures.
  .3 CAN/CSA G30.18-M92, Billet Steel Bars for Concrete Reinforcement.
  .4 CSA S413-07, Parking Structures.
  .5 CSA W47.1-09 Certification of Companies for Fusion Welding of Steel Structures.
  .6 CSA W186-M1990 (R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction

.2 Ontario Provincial Standard Specification (OPSS):
  .1 OPSS 905, Construction Specification for Steel Reinforcement for Concrete.

.3 ASTM International:
  .1 ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  .2 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
  .3 ASTM A497/A497M-07, Standard Specification for Steel Welded Wire Reinforcement, Deformed, For Concrete.

.4 Reinforcing Steel Institute of Canada (RSIC):
  .1 RSIC, Reinforcing Steel Manual of Standard Practice (2004).

.5 International Conference of Building Officials (ICBO):
  .1 ICBO Research Report.

1.4 QUALITY ASSURANCE

.1 Welder Qualifications: CSA W47.1 and CSA W186 certified.

1.5 SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Shop Drawings:
  .1 Submit reinforcement drawings prepared in accordance with the RSIC Manual of Standard Practice.

.2 Design and detail lap lengths to CAN/CSA A23.3. Supply Class B splices unless shown otherwise on the Contract Drawings. Splices are to be staggered unless otherwise shown on the Contract Drawings.

.3 Submit placing drawings, bar lists, quantities and bar bending details. Bar bending details shall include details of standard bends. Indicate the name of the bent bar Fabricator, name of bulk steel Supplier and steel grade.

.4 On placing drawings, indicate bar sizes, spacing, location and quantities of reinforcement, splices, splice lengths, location of expansion, control and construction joints, with identifying code marks to permit correct placement without reference to structural drawings. Indicate the sequence of placing concrete. Indicate type, sizes, spacings and locations of chairs, spacers and hangers.

.5 If bar list and bending schedule contain details of bars of more than one reinforcing bar placement drawing, then arrange bar marks in separate groups for each placement drawing. Clearly indicate for each bar mark the corresponding reinforcing bar placement drawing number.

.6 For slabs, show a separate plan indicating concrete thicknesses, reinforcing bars, and dowels for walls and columns cast in slab.

.7 For walls, show separate elevations indicating concrete thicknesses, reinforcing bars, and dowels for slabs and adjacent walls cast in wall.

.8 Show position and size of openings in slabs and walls. Cooperate with trades requiring openings to ascertain necessary information.

.9 Do not add new information on previously reviewed shop drawings.

.10 Reinforcing bar placement shop drawings will be reviewed for bar sizes, locations, and spacing, and will be stamped and signed. Bar list and bending schedule will not be reviewed or stamped.

.11 Submit shop drawings of dowel bar splicers, detailing locations, sizes, and types.

.12 Substitution of different size bars may be permitted upon written acceptance of the Consultant.

.13 Reproduction of the Contract Drawings for use as shop drawings is not permitted. Do not use Contract CAD files.

.3 Product Data Sheets:

.1 Submit three copies of the Manufacturer's Product data sheets including installation and maintenance instructions for: chairs, bolsters, bar supports, and side form spacers, dowel bar splicers, and mechanical splices.

.4 Test Reports:

.1 Submit certified copies of mill test reports for reinforcing steel and welded wire fabric, showing physical and chemical analysis, a minimum of 30 Days prior to commencing the Work. Determine physical and chemical properties of steel reinforcing in accordance with requirements of CSA-G30.18.

.5 Certificates:

.1 Submit welding certificate in accordance with CSA W47.1 and CSA W186-M.

.6 Information Submittals:
- .1 Submit in writing the proposed source of reinforcement material to be supplied.
- .2 Dowel Bar Splicers:
  - .1 Verification that device threads have been tested and meet the requirements for thread quality, in accordance with the Manufacturer's published methods.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 60 00 and with the Manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to Site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists. Clearly indicate mill run for which bars were fabricated.

.4 Storage and Handling Requirements:
- .1 Store reinforcing steel off the ground and kept free of mud, dirt, oil and any contaminants which may adversely affect performance of reinforcing steel. Comply with CSA A23.1/A23.2.
- .2 Store welded wire fabric sheets flat and off the ground.
- .3 Deteriorated or contaminated materials will be rejected and shall be removed from site.
- .4 Replace defective or damaged materials with new materials at no additional cost to the Owner.

2 Products

2.1 MATERIALS

.1 Substitution of different size bars may be permitted upon written acceptance of the Consultant.

.2 Reinforcing Bars:
- .1 Reinforcing steel: CAN/CSA G30.18-M; Carbon-steel bars, deformed unless indicated otherwise in the Contract Documents, Grade 400R.
- .2 Weldable reinforcing steel: CAN/CSA-G30.18-M; Weldable low alloy steel bars, where welding of reinforcing bars is indicated in the Contract Documents, deformed, Grade 400W.
- .3 Plain round reinforcing steel: CAN/CSA G30.18-M; round, Grade 400R, for expansion joints.
- .4 Do not substitute with epoxy-coated bars.

.3 Welded steel wire fabric: ASTM A82/A82M; Resistance welded in size and spacing shown for smooth wire fabric and ASTM A497/A497M for deformed wire fabric, in flat sheets only.

.4 Cold-drawn annealed steel wire ties: to ASTM A82/A82M, minimum 1.6mm diameter, with coating for use with uncoated and coated reinforcing steel.

.5 Bar Supports and Spacers:
- .1 Adequate for accurate placing and as required for construction loads.
- .2 Provide non-conductive bar supports in contact with exposed surfaces that has geometry and bond characteristics that prevents moisture movement from the surface to the reinforcement.
- .3 In beams, columns, walls, and slabs exposed to view after form removal: Small concrete blocks made up of same color and strength as concrete being placed around them.
- .4 Do not use plastic or stainless steel bar supports or side form spacers.
- .5 Design and fabricate special bar supports for top reinforcing bars in slabs where standard bar supports are not high or strong enough.

.6 Mechanical Splices:
- .1 Mechanical Threaded Connections: Furnish metal coupling sleeve with internal threads engaging threaded ends of bars, capable of developing in tension or compression 125% of yield strength of bar.
  - .1 Conform to CSA A23.3.
  - .2 Provide a thread-in plastic plug to protect the threads.
  - .3 Wrap exterior with tape.
  - .4 Clip the mounting washer, if provided, to maintain cover without displacing the bar.

2.2 FABRICATION

.1 Fabricate and bend reinforcing steel in accordance with CAN/CSA-A23.1/A23.2, RSIC Manual of Standard Practice and in accordance with the accepted placing drawings.

.2 Reinforcing Bars:
- .1 Use longest bar possible.
- .2 Shear and bending Tolerances:
  - .1 Length: ±25mm.
  - .2 Outside dimensions of stirrups, ties, and spirals: ±13mm.
  - .3 Other bends: ±25mm.
  - .4 Where increases cause interference with waterstop- plus 0mm.
  - .5 Ensure cutting and bending tolerances are sufficiently accurate to comply with placing tolerances shown.
- .3 Keep number of splices to a minimum.
- .4 Do not weld chairs, bolsters, bar supports, or spacers to reinforcing bars.

.3 Reinforcing Splices:
- .1 Lap Splices: Splice by lapping reinforcing bars, unless specified otherwise in the Contract Documents.
- .2 Welded Splices: Full penetration direct butt splice welds in accordance with CSA W186 and as specified in the Contract Documents.
- .3 Splices in Wire Fabric: Comply with CSA A23.3.
- .4 Obtain prior written approval from the Consultant for locations of reinforcement splices other than those shown on the placing drawings.

.4 Bend bars cold, heating of bars will not be permitted.

.5 Verify elevations before cutting and bending reinforcing bars.

.6 Obtain written approval from the Consultant prior to welding reinforcement. Weld reinforcement in accordance with CSA W186-M.

3 Execution

3.1 PREPARATION

.1 Notify Consultant a minimum 1 week in advance of when reinforcing is ready for inspection.

.2 Clean reinforcing bars of loose rust, mill scale, dried cement paste, mud, oil, or other coatings that will affect adhesion in accordance with CSA A23.1/A23.2, Clause 6.1.5 – Surface Condition of Reinforcement, prior to placing concrete.

.3 Coat wire projecting from bar supports with dielectric material or plastic.

3.2 FIELD BENDING

.1 Do not field bend or field weld reinforcement without prior written approval by the Consultant.

.2 When field bending is authorized, bend without heat, applying a slow and steady pressure. Required radius of bend shall be provided in accordance with CSA A23.4.

.3 Replace bars which develop cracks or splits.

3.3 REINFORCEMENT BAR INSTALLATION

.1 Prior to installation of reinforcing steel, inspect installed Work of other trades and verify that Work is complete for installation of reinforcement.

.2 Place reinforcing steel as shown on reviewed placing drawings and in accordance with CSA A23.1/A23.2.

.3 Use plain round bars as slip dowels in concrete.

.1 Paint the portion of dowel intended to move within hardened concrete with one coat of asphalt paint.

.2 When paint is dry, apply a thick even film of mineral lubricating grease.

.4 Tie bars at least at every fourth intersection minimum. Make maximum untied length 1000mm.

.5 Do not eliminate or displace reinforcement to accommodate hardware to be embedded in concrete.

.6 Do not field bend bars partially embedded in concrete except as shown on the Contract Drawings or as accepted by the Consultant.

.7 Prior to placing concrete or closing wall and column forms, obtain acceptance of reinforcing steel and position from Consultant.

.8 Ensure cover to reinforcement is maintained during concrete pour.

.9 Splicing:

.1 Use lap splices, unless otherwise shown on the Contract Drawings or permitted in writing by the Owner’s Representative.

.2 Welded Splices: Accomplish by full penetration groove welds and develop a minimum of 125% of yield strength of bar in tension and compression.

.3 Stagger splices in adjacent bars.

.10 Dowel Bar Splicers:

.1 Use only in areas specifically approved in writing by the Owner's Representative.

.2 Install threaded rods as recommended by Manufacturer with threads totally engaged into coupling sleeve and in accordance with ICBO Research Report.

.3 Install dowel bar splicers with plastic setting plugs.

.4 Lightly grease internal threads in accordance with manufacturers printed instructions.

.5 Maintain minimum edge distance and concrete cover as noted in the Contract Drawings.

.11 Mechanical Splices:

.1 Install mechanical splices in accordance with the Manufacturer's written instructions. Request the presence of the Manufacturer's representative to verify proper installation.

.12 Tying Reinforcing Bars:

.1 Bend tie wire away from concrete surface. Ensure that the cover for tie wires, form tie bolts, etc. are the same as the reinforcing bars. Do not let reinforcing tie wire touch formwork or be exposed in the finished concrete structure.

.13 Reinforcement Around Openings: On each side and above and below pipe or opening, place an equivalent area of steel bars to replace steel bars cut or disrupted for opening. Extend steel reinforcing a standard lap length beyond opening at each end.

.14 Welding Reinforcement:

.1 Only Type W bars may be welded.

.2 Do not perform welding until welder qualifications are approved.

.15 Do not field cut reinforcement except where indicated or authorized in writing by the Consultant.

3.4 PROGRESS CLEANING

.1 Leave the Work areas clean at end of each Working Day.

.2 Final Cleaning: Upon completion of reinforcing steel installation, remove surplus materials, rubbish, tools and equipment and verify that the area ready for placing concrete.

END OF SECTION

1 General

1.1 SUMMARY

.1 Supply all labour, materials, equipment, fuel, services and perform all operations required to complete cast in place concrete installation.

1.2 RELATED REQUIREMENTS

.1 Section 03 10 00
.2 Section 03 20 00

1.3 REFERENCES

.1 CSA International:
- .1 CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .2 CSA A283-06 (R2011), Qualification Code for Concrete Testing Laboratories.
- .3 CSA A3000-13, Cementitious materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .4 CAN/CSA-G30.18-09: Carbon Steel Bars for Concrete Reinforcement.
- .5 CSA S413-07, Parking Structures.

.2 ASTM International:
- .1 ASTM C260-06, Standard Specification for Air-Entraining Admixtures for Concrete.
- .2 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- .3 ASTM C494/C494M-11, Standard Specification for Chemical Admixtures for Concrete.
- .4 .ASTM C1017/C1017M-07, Standard specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- .5 ASTM D1751-04 (2008), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- .6 ASTM C1059/C1059M-99 (2008), Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
- .7 ASTM D6690-07, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
- .8 ASTM D1752-04a (2008), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .9 ASTM D638-10, Standard Test Method for Tensile Properties of Plastics.
- .10 ASTM D412-06, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers Tension.
- .11 ASTM C109/C109M-13, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars using 50-mm Cube Specimens.
- .12 ASTM C1315, Standard Specification for Liquid Membrane-Forming Compound having Special Properties for Curing and Sealing Concrete.

.3 American Concrete Institute (ACI):
.1 304.2R Placing Concrete by Pumping Methods.

.4 Canadian General Standards Board (CGSB):
.1 CAN/CGSB 37.2-M88, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
.2 CAN/CGSB 51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

1.4 ABBREVIATIONS AND ACRONYMS

.1 Cement: hydraulic cement or blended hydraulic cement (XXb - where b denotes blended).
.1 Type GU or GUb - General use cement.
.2 Type MS or MSb – Moderate sulphate-resistant cement.
.3 Type MH or MHb - Moderate heat of hydration cement.
.4 Type HE or Heb - High early-strength cement.
.5 Type LH or LHb - Low heat of hydration cement.
.6 Type HS or HSb – High sulphate-resistant cement.

.2 GGBFS - Ground, granulated blast-furnace slag.

1.5 DEFINITIONS

.1 Exposed Concrete: Concrete surfaces that can be seen inside or outside of structures including surfaces above water.

.2 Surface Defects: Surface areas that include honeycomb, rock pockets, indentations greater than 5mm, cracks 0.25mm wide and larger, spalls, chips, air bubbles greater than 20mm in diameter, pinholes, bug holes, embedded debris, lift lines, sand lines, bleed lines, leakage from form joints, fins and other projections, form pop outs, texture irregularities, and stains and other colour variations that cannot be removed by cleaning.

.3 Defective concrete: As defined in subsection 1.5.6 – Defective concrete, below.

.4 New Concrete: Less than 60 Days old.

1.6 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 40 00.

.2 Ready Mixed Concrete Producer: Certified member in good standing of the Ready Mixed Concrete Association of Ontario.

.3 Inspection and tests:
.1 Materials: CSA A23.1/A23.2.
.2 Tests will be performed in accordance with CSA A23.1/A23.2.
.3 Cooperate with and assist the independent testing agency and the Consultant during inspections and tests.
.4 Remove defective materials and completed work which fails tests and replace as directed by the Consultant.
.5 Inspection or testing by the Consultant will not augment or replace the Contractor's quality control nor relieve the Contractor of its contractual responsibility.

.4 Test Panels
- .1 Provide test panels 1.8m x 1.2m in size for the Consultant's approval before starting the work of the following schedule:
  - .1 Plain concrete:
  - .2 Number 2 finish for slabs.
- .2 Show on panels the specified finish including formwork tie holes and plugs.
- .3 Erect panels individually or build-in on-site in areas selected by the Consultant.
- .4 Form as many panels as necessary until written approval has been issued by the Consultant.
- .5 Upon approval, maintain sample panels in place throughout the duration of the Contract as the standard of workmanship to be adhered to.
- .6 Upon completion of the concrete work, remove and dispose of the test panels off-site.

.5 Defective concrete:
- .1 Concrete strength:
  - .1 Strength acceptance criteria from cylinder tests will be in accordance with CSA A23.1/A23.2.
  - .2 Concrete shall be considered defective when a cylinder test fails to meet the performance requirements for the corresponding concrete type, as defined in subsection 2.2 – Concrete Mixes, below.
  - .3 In such cases, the Consultant may require further action or testing in accordance with CSA A23.1, Clause 4.4.6.7 – Failure of Standard-Cured Cylinder Test Results to Meet Requirements.
- .2 Concrete may be considered defective if it is structurally unsound, lacks moisture resistance, has surface defects, the measured air content fails to meet performance requirements or is improperly finished, as determined by the Consultant.
- .3 The Consultant has the right to require replacement, strengthening or correction of impacted portions of defective concrete structure, in accordance with Clause 4.4.6.7.2 of CSA A23.1.
- .4 The Contractor shall bear all costs of rectifying defective concrete including inspections, design, coring, testing, strengthening, demolishing, and replacement. The Contractor shall also bear investigation and evaluation costs even if further evaluation of the design allows the unit to be classified as acceptable concrete.

.6 Concrete delivery:
- .1 There shall be a maximum time limit of 120 minutes from the time of initial mixing to complete discharge, in accordance with CSA A23.1 Clause 5.2.4.3.1 – Time of Delivery.

.7 Records:
- .1 Before unloading at Site, have the concrete producer submit to the Consultant a delivery ticket (with each batch of concrete) on which is printed, stamped or written the following information:
  - .1 Name and location of batch plant.
  - .2 Date and serial number of ticket.

.3 Name of Contractor.
.4 Contract Name and Contract number.
.5 Concrete Mix Design Submission Form number, specified strength, target slump and air content at end of chute.
.6 Amount of concrete in cubic metres.
.7 Truck number, cumulative total, and/or load number.
.8 Time loaded or time of first mixing of cement and water/aggregate.

.2 Include the following information, which is to be registered by the producer's representative on at least two copies of the delivery ticket, after discharge has been completed:
.1 Time that load arrived on-site.
.2 Time that discharge of load was started.
.3 Time that discharge of load was completed.
.4 Type and amount of admixtures. If added at Site, initialed by the Consultant.

.3 Maintain accurate records of cast-in-place concrete elements. Include in the records the following information:
.1 Date of placing concrete element.
.2 Location of concrete element.
.3 Specified strength of concrete.
.4 Air and form temperature when concrete was placed.
.5 Temperature of concrete when placed in the form.
.6 Test samples taken and results of test samples.

.8 The Owner, in consultation with the Consultant, will appoint an independent inspection and testing company to verify compliance with this Specification in accordance with Section 01 40 00. Cooperate and coordinate with the Inspector to facilitate inspection.

1.7 SUBMITTALS

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

.2 Certificates:
.1 Submit a current, valid “Certificate of Ready Mixed Concrete Production Facilities” as issued by the RMCAO for plants supplying concrete to the Contract.
.2 Submit certification from the concrete producer that a Professional Engineer licensed in the Province of Ontario has designed the mixes based on the requirements of the Specifications and that the concrete mixes will produce concrete meeting the performance requirements of the Specification Sections.
.3 Submit certification demonstrating that aggregates will not, nor have the potential to, react with cement to result in deleterious expansion in the concrete. Ensure these tests are current and represent the aggregates being supplied.
.4 Submit certifications with the concrete mix design, that all concrete constituents are compatible.

.3 Quality Control Plan:
- .1 Submit for review by the Consultant the Quality Control Plan which describes the material, equipment and procedures to be used for the following activities:
  - .1 Uniform and consistent concrete finishing.
  - .2 Cold weather protection when the air temperature is at or below 5°C.
  - .3 Hot weather protection when the ambient air temperature is at above 27°C.
  - .4 Concrete curing.
  - .5 Concrete placing.
  - .6 Temperature Management Plan including temperature monitoring and corrective measures.
- .2 Submit concrete delivery records.

.4 Records
- .1 Concrete pours: Maintain and submit accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken, as described in subsection 3.8 - Field Quality Control, below.
- .2 Concrete hauling times: Maintain and submit records of deviations from the maximum allowable time of 120 minutes for concrete delivery.

.5 Shop Drawings:
- .1 Master Plan(s) of Concrete Placements:
  - .1 Before submitting shop drawings of formwork, falsework and reinforcing bars, submit master plan(s) showing separate concrete placements and the locations of all expansion, isolation, control and construction joints, including any proposed construction joints that are in addition to those indicated on the Contract Drawings.
  - .2 Show layout and location for each type of joint, including expansion and construction joints.
  - .3 Show elevation or section taken through the plane of the joint showing the walls and slabs at the joint.
  - .4 Show details of joint fillers, sealant, adhesives, and other appurtenances.
  - .5 Show details of concrete inserts, including location, size, type and surface treatments.
- .2 Concrete Placing Schedule:
  - .1 Submit concrete placing schedule.

.6 Concrete Mix Designs:
- .1 Submit proposed performance mix design data, and the Supplier's applicable standard deviations.
- .2 Tabulate concrete mixes. Indicate the types of cement, size of coarse aggregate, water/cementing material ratio, admixtures used, air content, slump, and the locations of use for each mix.
- .3 For high slump flowing concrete submit a mix that will not result in segregation.

.7 Test Panels
- .1 Provide test panels as specified in subsection 1.5 – Quality Assurance.

.8 Trial Mix Design Prequalification Test Results:
- .1 Submit specified trial mix test results with the mix design as performed by an independent laboratory in accordance with CSA A23.1/A23.2.
- .2 Identify the course of action to be taken if the testing program indicates that the requirements of the Contract Documents have not been met.
- .3 Submit test data three weeks prior to concrete placement showing that the concrete supplied meets the performance criteria stated for each concrete types listed in subsection 2.2 – Concrete Mixes, below:
  - .1 At a minimum, the prequalification mix design test data shall prove that the minimum compressive strength, chloride ion content penetrability (for C-1 class of exposure), density, shrinkage and air content of hardened concrete to be supplied meets or exceeds the performance criteria.
  - .2 Trial batching shall replicate the actual batching practices and placing procedures at the Site and the tests shall be based on the concrete samples taken from the point of discharge into the formwork.
  - .3 All prequalification testing of concrete and concrete constituents by the Contractor shall be done by a laboratory certified in accordance with CSA A283 for the appropriate category of testing.
  - .4 For standard mix (concrete mix that has been used before and is proposed to be used without any alterations of the mix design), historical test data that statistically demonstrates conformance to the Specification requirements may be submitted in lieu of mix design prequalification (trial batch testing), subject to review by the Consultant.

.9 Field Quality Control Test Results:
- .1 Submit reports of results for each of the following field tests, and as described in subsection 3.8 – Field Quality Control, below:
  - .1 Concrete pours.
  - .2 Slump.
  - .3 Air content.
  - .4 Compressive strength at 7 and 28 Days.
  - .5 Air and concrete temperature.

.10 Product Data and Samples:
- .1 Submit technical data and samples, where noted with quantities, of proposed materials including installation, application, and maintenance instructions for:
  - .1 Joint filler (100mm length of each type).
  - .2 Curing compound.
  - .3 Evaporation retardant.
  - .4 Surface sealer.
  - .5 Floor hardener.
  - .6 Chemical hardener.
  - .7 Polyethylene sheet.

.11 Submit a Construction Waste Management plan as described in subsection 3.16 – Cleaning, below.

1.8 TRIAL MIXES

.1 Prior to the start of on-site concrete construction, undertake trial mixes of each structural concrete mix design.

.2 Submit test results from trial mixes confirming workability and concrete strength.

.3 Undertake linear shrinkage testing of the trial mixes and submit test results.

.4 Adjust mixes that do not provide adequate performance, and re-test.

1.9 PRE-PLACEMENT MEETING

.1 Hold a meeting a minimum of 28 Days prior to the initial placement of concrete to review the detailed requirements for preparing the concrete design mixes, finishes, and procedures for concrete placement for the structures.

.2 Ensure key personnel, Site Supervisor, Consultant, concrete formwork and finishing Sub-Contractors, concrete pumping and conveying equipment Supplier, concrete producer and testing laboratories attend.

.3 Notify the Consultant a minimum of 10 Working Days prior to the scheduled date of the meeting.

.4 Provide an agenda for the meeting a minimum of 5 Working Days prior to the scheduled date of the meeting,

.5 Provide minutes of the meeting within 5 Working Days after the meeting. Circulate to all parties.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Comply with the Manufacturers' recommendations for delivery, storage, and handling.

.2 Store materials in a manner that will prevent deterioration or contamination. Deteriorated or contaminated materials will be rejected and must be removed from the Site.

.3 Concrete:

- .1 Deliver and store materials on Site in accordance with CSA A23.1/A23.2.
- .2 Site-mixed concrete shall not be permitted.
- .3 Concrete, mixed off-site:
  - .1 When the truck mixer or agitator is accepted for mixing or delivery of concrete, do not add admixtures or water to batch after the initial introduction of mixing.
  - .2 If measured slump or entrained-air content falls outside specified limits, ensure another portion of the same sample is tested immediately. If second failure occurs, concrete will be considered to have failed the requirements of the Specification and will be rejected.

.4 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials.

1.11 SITE CONDITIONS

.1 Do not place concrete during or prior to rain.

.2 Prevent rain from reaching newly placed concrete in accordance with CSA A23.1/A23.2

.3 Cold weather protection:

- .1 Maintain protection equipment, in a state of readiness, on Site. Use such equipment when the ambient temperature is at or below 5°C, or when, in the opinion of the Consultant the temperature may fall below 5°C before concrete has cured.
- .2 Do not place concrete upon or against a surface that is at temperature lower than 5°C.
- .3 Provide temperature-controlled enclosures for areas where concrete is placed whenever ambient air temperature is 5°C or lower.
- .4 Protect concrete from the adverse effects of space-heated enclosures including local overheating and combustion products.
- .5 Heat mix water and, if necessary, aggregates when air temperature is at or below, or predicted to go below, 5°C at any time during the next 24 hours.
- .6 Maintain temperature of reinforcing bars and forms above 10°C prior to placing concrete.
- .7 Maintain temperature of concrete when deposited in forms not less than 15°C but not higher than 25°C.
- .8 Maintain temperature of concrete at surfaces at least 10°C for a minimum period of 7 Days after placing and achieving minimum 75% of specified strength. Concrete temperature may then be lowered to ambient air temperature at a rate of 0.5°C per hour or 10°C per day.
- .9 Use additional protection if full 28 Day compressive strength is required at an early age.
- .10 Keep concrete continuously moist during the curing period.
- .11 Obtain the Consultant's acceptance of the method of maintaining minimum temperatures.

.4 Hot weather protection:

- .1 Maintain protection equipment in a state of readiness on Site. Use such equipment when the ambient temperature is at or above 27°C, or when, in the opinion of the Consultant the temperature may exceed 27°C before concrete has cured.
- .2 When ambient temperature is at or above 27°C, protect concrete from direct sunlight and keep forms moist by sprinkling with cool water, applying wet burlap, or other accepted methods of cooling that will not adversely affect the concrete.
- .3 Do not place concrete when the concrete temperature exceeds 27°C in the mixer.
- .4 Concrete, which has a temperature in the mixer between 20°C and 27°C shall:
  - .1 Contain a retarder which reduces mixing water requirements and increases strength.
  - .2 Not contain high early strength cement.

.5 Protect forms and equipment, including both mixing and placing equipment, from the rays of the sun and cool by wetting as necessary to maintain a temperature of not more than 5°C in excess of the ambient temperature nor more than 30°C.

.6 Prior to placing concrete, wet down forms and reinforcement and the area surrounding the work. Ensure that excess water is swept and drained away immediately before casting the concrete.

.7 Keep mixing time to the minimum, consistent with the production of the quality of concrete specified and place mixed concrete immediately.

.8 Use sufficient qualified personnel for rapid placing and finishing of concrete.

.9 Commence continuous wet curing as soon as the concrete has hardened sufficiently to prevent surface damage.

.5 Protection from drying:

.1 When the rate of surface moisture evaporation exceeds 0.50kg/m²/h, take additional measures to prevent rapid loss of moisture from surface of concrete as accepted by the Consultant and in accordance with CSA A23.1 Clause 7.4.1.2 – Severe Drying Conditions.

.6 Frost Protection for Footings and Slabs on Grade:

.1 Protect subgrades below proposed concrete work. Ensure that subgrade temperatures are a minimum of 10°C when the concrete is placed.

.2 Provide continuous protection for footings and slabs on grade to prevent the sub-grade below from freezing during cold weather. Provide heated enclosures and insulation as required.

.7 Influence of Ambient Concrete Temperature on Concrete Crack Control:

.1 To minimize the formation of thermal cracks during placement and curing, maintain previously cured concrete and concrete that will be placed against it at the same temperature.

.2 Failure to minimize temperature differential between adjacent pours may result in temperature induced cracking. Repair such cracks as specified in this Section.

.8 Backfilling and Service Loads Restrictions:

.1 Obtain approval from the Consultant prior to backfilling around structures.

.2 Verify that the backfill is not higher than the finished grades indicated in the Contract Documents.

.3 Verify that equipment for backfilling and compaction on top of slabs will not impose loads greater than those indicated in the Contract Documents.

.4 Verify that concrete in walls, and slabs, struts, and cross walls, which frame into the walls providing lateral stability, has been placed and has attained the specified compressive strength before backfilling against walls or subjecting walls to service loads.

.5 Verify that concrete in slabs, including slabs on grade supported by piles or caissons, and support components, have reached the specified compressive strengths before backfilling or subjecting slabs to service loads.

2 Products

2.1 MATERIALS

.1 General:
- .1 Use admixtures for concrete conforming to CSA A23.1/A23.2, unless otherwise acceptable to the Consultant.
- .2 Have the concrete producer certify that admixtures are compatible.
- .3 Use Products in accordance with the manufacturer's printed instructions unless otherwise acceptable to the Consultant.
- .4 Fresh concrete to be normal density concrete (2350kg/m³ ± 100kg/m³), unless otherwise noted in Part 2.2 – Concrete Mixes.

.2 Cement and supplementary cementing materials: in accordance with CSA A3001:
- .1 For use in general concrete construction, when the special properties of other cement types are not required, Portland cement Type GU or blended hydraulic cement type GUb shall be used.
- .2 Should the Contractor choose to include silica fume cement in the concrete mix design, the substitution of silica fume shall not exceed 8% by mass of Portland cement.
- .3 Should the Contractor choose to include fly ash in the concrete mix design, the substitution of fly ash shall not exceed 25% by mass of Portland cement.
- .4 Should the Contractor choose to include a Ground Granulated Blast Furnace Slag (GGBFS) in the concrete mix design, the substitution of GGBFS shall not exceed 50% by mass of Portland cement, unless specifically accepted by the Consultant.

.3 Aggregates:
- .1 Course aggregates: In accordance with CSA A23.1/A23.2. All aggregate sources as listed on the MTO's designated Source Materials (DSM) list.
- .2 Fine aggregates: In accordance with CSA A23.1/A23.2.

.4 Water: in accordance with CSA A23.1/A23.2.

.5 Admixtures:
- .1 Air entraining admixture: in accordance with CSA A23.1/A23.2 and ASTM C260/C260M.
- .2 Chemical admixture: in accordance with CSA A23.1/A23.2, ASTM C260 and ASTM C494. The Consultant is to approve accelerating or set retarding admixtures during cold and hot weather placing.
  - .1 Water-reducing admixture: ASTM C494/C494M, Type A.
  - .2 Retarding admixture: ASTM C494/C494M, Type B.
  - .3 Accelerating admixture: ASTM C494/C494M, Type C.
  - .4 Water-reducing and retarding admixtures: Type D.
  - .5 Water-reducing and accelerating admixture: Type E.
  - .6 Water-reducing high range admixture (super plasticizers): Type F.
  - .7 Water-reducing, high range and retarding admixtures (super plasticizers): Type G.
  - .8 Specific performance admixtures: Type S.

.6 Curing compound: to CSA A23.1/A23.2 white.

.7 Non-shrink grout: Shrinkage compensating grout, pre-mixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
- .1 Compressive strength: 40 MPa at 28 Days.

.8 Non premixed dry pack grout: composition of non-metallic aggregate Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 40 MPa at 28 Days.

.9 Dry Pack Material: One part cement and three parts sand (fine aggregate) by volume. Add water to obtain a consistency that when a sample is squeezed, only enough water will come to the surface to moisten hand. Maximum water content shall be 4.5L to 23kg of cement.

.10 Dovetail anchors and slots: Minimum 0.64mm thickness, Z275 zinc coated galvanized steel with fillers to prevent entry of concrete during pouring and minimum 2mm overall thickness.

.11 Rigid insulation: In accordance with CAN/ULC S701 Type 4, extruded polystyrene:
- .1 Low Density Insulation:
  - .1 Styrofoam brand, SM Extruded Polystyrene Foam Insulation by Dow Chemical Canada ULC.
  - .2 Foamular C-300 Extruded Polystyrene Rigid Insulation by Owens Corning Canada.
- .2 High Density Insulation:
  - .1 Styrofoam brand, Highload 40 (Hi-40) Extruded Polystyrene Insulation by Dow Chemical Canada ULC.
  - .2 Foamular 600 High Density Extruded Polystyrene Rigid Insulation by Owens Corning Canada.

.12 Drilled Anchors:
- .1 HIT-HY 200 System by Hilti (Canada) Corporation.
- .2 HSL-3 Heavy Duty Expansion Anchor by Hilti (Canada) Corporation.

.13 Bond breakers: 810-07 Non-Fibered Asphalt Roof and Foundation Coating by Henry Company Canada Inc.

.14 Pre-moulded joint fillers:
- .1 Bituminous impregnated fibre board: in accordance with ASTM D1751.
- .2 Sponge rubber: in accordance with ASTM D1752, Type I, flexible firm grade.
- .3 Self-expanding Standard cork: in accordance with ASTM D1752, Type III.

.15 Surface hardener:
- .1 Factory premixed natural emery aggregates with Type GU normal Portland cement, superplasticizers and wetting agents:
  - .1 EmeriCrete SH by Sika Canada Inc.
  - .2 CPD Floor Hardener Pre-mix (Premium) by CPD Construction Products.
  - .3 MBT brand, Mastercron Ff by BASF – Building Systems.

.16 Sump Pit Waterproofing:
- .1 Primer and Moisture Control: Penetrating two-component primer and moisture control system, standard colour, 3mm to 4mm dry film overall system thickness.
- .2 Coating: Chemical resistant, semi-gloss finish, standard colour, 2.5mm dry film overall system thickness; single application.
- .3 Filler and Grout: Compatible with coating and as recommended by the coating Manufacturer.
- .4 Joint Backing: Preformed, compressible strips of closed cell polyethylene or urethane foam, rubber tubing or non-migrating plasticized vinyl, oversized 25%, compatible with sealant, primer, epoxy surfacing and substrate.
- .5 Joint Sealant: CAN/CGSB-19.24-M, Type 1, Class B, multi-component modified urethane base chemical curing; material compatible with the coating and as recommended by the coating manufacture.

2.2 CONCRETE MIXES

.1 Performance Requirements:
- .1 Proportion concrete for structures to create high performance concrete with improved durability, reduced shrinkage and reduced cracking.
- .2 Density: Normal density.
- .3 Linear Shrinkage:
  - .1 Limit linear shrinkage to 0.040% after 28 Days drying for 40mm aggregate concrete and 0.045% after 28 Days drying for 20mm aggregate concrete.
- .4 Durability Design Life
  - .1 Provide concrete produced under this Section with an expected design life of at least 70 years for the service conditions defined by the usage, and the exposures specified in the Contract Documents.

.2 General:
- .1 Establish proportions of cementing materials, aggregates, water, and admixtures required to produce consistent workable concrete with strength and other properties specified, in accordance with CSA A23.1/A23.2.
- .2 Design concrete so that material will not segregate, and excessive bleeding will not occur.
- .3 Use same types and brand of cement throughout.
- .4 Comply with and allow for the supplier's Standard Deviation as specified in CSA A23.1/A23.2, Clause 4.4.6.7 Compressive Strength Requirements.
- .5 Admixtures plant added with the mix water.

.3 Unshrinkable fill: Ontario Provincial Standard Specification OPSS 1359.

.4 Mixes for Normal Density concrete:
- .1 High performance concrete for foundations, footings and foundation walls:
  - .1 Class F-1 exposure.
  - .2 30 MPa at 28 Days.

.3 Maximum aggregate size 40mm for slab greater than 400mm thickness and 20mm unless the slab is less than or equal to 400 mm thickness.

.2 Concrete grout for starting structural walls below-grade at construction joint:
- .1 Class F-1 exposure.
- .2 30 MPa at 28 Days.
- .3 Utilize mix 1 above without the coarse aggregate.

.3 High performance concrete for interior slabs, including slabs-on-grade and slabs-on-deck:
- .1 Class N exposure.
- .2 32 MPa at 28 Days.

.4 Exterior reinforced concrete slabs:
- .1 Class C-1 exposure.
- .2 35 MPa at 28 Days.
- .3 Air content category 1.
- .4 Maximum aggregate size 40mm for slab greater than 400mm thickness and 20mm for slabs less than or equal to 400 mm thickness.

.5 Exterior unreinforced concrete slabs, pavements, sidewalks and curbs:
- .1 Class C-2 exposure.
- .2 32 MPa at 28 Days.
- .3 Maximum aggregate size 40mm for slab greater than 400mm thickness and 20mm for slabs less than or equal to 400 mm thickness.

.6 Lean fill, pipe bedding, duct banks, encasements, underpinning and skim slabs:
- .1 Class N exposure.
- .2 15 MPa at 28 Days.
- .3 Maximum aggregate size 20mm.

.5 Mix for Pumped Concrete:
- .1 Comply with the requirements of ACI 304.2R and this Section.
- .2 Use coarse and fine aggregate with a uniform grading curve.
- .3 Superplasticizing admixture may be used for pumped concrete.
- .4 Do not use admixtures which promote bleeding.

3 Execution

3.1 RELEASES

.1 Obtain the Consultant's release:
- .1 For reinforcement, formwork, falsework, and inserts as placed.
- .2 To commence placing concrete.

.2 Provide the Consultant with written notice of the Contractor's intent to pour between 24 hours and 7 Days prior to the pour.

.3 Provide a completed Concrete Pour Release Form (attached as a supplement to this Section) prior to each pour and allow the Consultant 2 hours for their review.

.4 Do not order concrete until the Concrete Pour Release Form has been signed by the Consultant.

3.2 PREPARATION

.1 Obtain written approval from the Consultant before placing concrete. Provide 24 hours minimum notice prior to the placing of concrete.

.2 Place concrete reinforcing in accordance with Section 03 20 00.

.3 Remove water, snow, ice, loose soil, laitance, curing compound, wood, and other debris from surfaces on or against which new concrete will be placed.

.4 Roughen and clean surfaces of previously placed concrete against which subsequent concrete will be placed.

.5 During concreting operations:
- .1 The development of cold joints shall not be allowed.
- .2 Ensure concrete delivery and handling facilitates placing with minimum re-handling, and without damage to the existing structure or Work.

.6 Pumping of concrete is permitted only after the approval of equipment and mix.

.7 Ensure reinforcement and inserts are not disturbed during concrete placement.

.8 Prior to placing of concrete, obtain the Consultant's approval of the proposed method for protection of concrete during placing and curing.

.9 Protect the previous Work from staining.

.10 Clean and remove stains prior to application for concrete finishes.

.11 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

.12 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.
- .1 Place steel dowels of deformed steel reinforcing bars and pack solidly with non-shrink grout to anchor and hold dowels in positions as indicated in the design drawings.

.13 Do not place load upon new concrete until authorized by the Consultant.

3.3 MAXIMUM SIZE OF CONCRETE PLACEMENTS

.1 Limit the size of each placement to allow for strength gain and volume change due to shrinkage.

.2 Add construction joints as necessary to suit pour sizes. Confirm the joint location with the Consultant and adjust as necessary.

.3 Consider beams, girders, brackets, column capitals, and haunches as part of the floor or roof system above and place monolithically with the floor or roof system.

.4 Construction Joints in Unrestrained Slabs on Ground:
- .1 Base Slabs placed on the ground may be placed continuously from outside edge to outside edge, outside edge to expansion joint, or from expansion joint to expansion joint, unless shown otherwise on the Drawings.

.5 Construction Joints in Suspended Slabs Restrained by Connecting Walls:
- .1 Place slab in alternate strips with the larger dimension of any single placement no greater than 15,000mm for slabs.
- .2 Locate construction joints in suspended slabs near the middle quarter of the spans of slabs and beams, unless indicated otherwise on the Contract Drawings. If a beam intersects a girder at this location, offset the construction joint in the slab and girder by a distance equal to two times the depth of the beam.

.6 Construction Joints in Girders and Beams:
- .1 Construct concrete beams and suspended slabs monolithically, unless indicated otherwise on the Contract Drawings.
- .2 If vertical construction joints are required, provide shear key, and additional inclined shear reinforcing steel. The Consultant's review and acceptance is required for any joints added into girders and beams.

.7 Construction Joints in Walls:
- .1 Limit pours to a maximum of 6.5m vertically.
- .2 Allow 3 Days between adjacent pours.
- .3 Locate construction joints a minimum of 2,000mm away from any junction of two or more walls, a column or beam supported on a wall, the nearest edge of an opening wider than 600mm, and a construction joint in a slab on which the wall rests.
- .4 Place wall in alternate portions with a distance between vertical construction joints not exceeding 15,000mm for walls.

3.4 INSTALLATION/APPLICATION

.1 Prevent damage to waterproofing where concrete is poured against waterproofing.

.2 Sleeves and inserts:
- .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, slab drop panels, column capitals or columns, except where indicated or approved by Consultant.
- .2 Where approved by Consultant, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere in the Contract Documents.
- .3 Sleeves and openings greater than 100 x 100mm not indicated in design drawings must be reviewed by the Consultant.
- .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from the Consultant before the placing of concrete.
- .5 Confirm locations and sizes of sleeves and openings shown on the Drawings.
- .6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

.3 Anchor rods:
- .1 Prior to placing concrete, place anchor bolts in locations indicated on the reviewed shop drawings under the supervision of the trade supplying

anchor bolts and templates in accordance with the Manufacturer's printed instructions and in accordance with CSA A23.1/A23.2.

.4 Grout under base plates:
- .1 Grout under base plates using procedures in accordance with the manufacturer's recommendations that result in 100% contact over grouted area. Thoroughly compact leaving no voids.

.5 Joint fillers:
- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by the Consultant.
- .2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
- .3 Locate and form isolation, construction and expansion joints as indicated on the Drawings and as described in this Section.

.6 Horizontal Construction Joints in Reinforced Concrete Walls and Columns:
- .1 Thoroughly clean and saturate the surface of the joint with water.
- .2 For walls and columns, place grout onto the existing concrete before starting regular concrete placement. Limit wall and column grout placement to a maximum thickness of 50mm and a minimum thickness of 30mm.

.7 Dovetail anchor slots:
- .1 Install continuous vertical anchor slots to forms where masonry abuts concrete wall or columns.
- .2 Install continuous vertical anchor slots at 800mm o.c. where concrete walls are masonry faced. Anchors shall project to within 20mm minimum of masonry face.
- .3 Do not install anchor slots in underground concrete walls cast against excavation support systems.

3.5 PROTECTION AND CURING

.1 Protect and cure concrete in accordance with CSA A23.1, Clause 7.4 and Table 20.

.2 Protect freshly placed and finished concrete from adverse conditions such as premature drying, moisture loss, defacement due to building operations, and from excessive hot and cold temperatures, for the period of time corresponding to the required curing type of concrete.

.3 Commence protection immediately after placing to achieve the temperature and moisture conditions for the period of time necessary for the concrete to develop its required properties.

.4 Concrete elements shall be protected to limit the temperature differential between the concrete core and the concrete surface within 20°C.

.5 Protection shall not be removed until the concrete has cooled to the temperature differential given in the CSA A23.1, Table 21, in order to avoid cracking of the concrete due to the sudden temperature change near the end of the curing period.

.6 Removal of forms prior to the minimum curing period does not remove the Contractor's obligation to cure and protect the exposed concrete for the minimum time periods specified for curing and protection. Refer to CSA A23.1, Clause 7.4.1.5.3.4.

.7 Curing types based on CSA A23.1, Table 20, as modified in this Section:
- .1 Type 1 – Basic curing: 3 days at ≥10°C or for the time necessary to attain 40% of the specified strength.
- .2 Type 2 - Additional curing: 7 days total at ≥10°C and for the time necessary to attain 70% of the specified strength.
- .3 Type 3 - Wet curing: 7 days at ≥10°C and for the time necessary to attain 70% of the specified strength.
- .4 Note: Silica fume concrete must be wet cured.

.8 Wet Curing of Concrete:
- .1 When wet curing is required, start fog misting immediately after placing operations are completed, in order to prevent plastic shrinkage and cracking from taking place.
  - .1 Fog misting must be applied continuously from the time of screeding until concrete is covered with burlap or other moisture-retaining covering, in such a way as to maintain high relative humidity above the concrete and prevent drying of the concrete surface.
- .2 When concrete has set, cover horizontal surfaces with at least one layer of wet burlap or other moisture-retaining covering.
  - .1 Strips must overlap 150mm and must be held in place without marring the surface of the concrete.
  - .2 Provide suitable weights to prevent blow-off or displacement of protective cover.
  - .3 Burlap must be pre-soaked by immersing it in water for a minimum period of 24 hours prior to placing and must be maintained in a continuously wet condition throughout the curing period by means of a soaker hose.
  - .4 Do not permit intermittent drying.
  - .5 Remove burlap after a minimum of 7 consecutive Days and allow to air dry until the concrete has developed the specified design strengths.
- .3 Water must not be allowed to drip, flow or puddle on the concrete surface during fog misting, when placing the burlap or at any time before the concrete has achieved final set.

.9 Use of Curing Compounds and Evaporation Reducers:
- .1 Except where concrete wet curing is required, the use of pigmented curing compounds and evaporation reducers may be authorized by the Consultant.
- .2 Apply curing compound/evaporation reducer after placing or finishing operations have been completed, in accordance with the compound Manufacturer's printed instructions.
- .3 Ensure the compound application is uniform and continuous over entire area being cured.

.4 Where surfaces are to be exposed to sunlight, use compound with white pigment.

.5 Do not use curing compounds on surfaces where a bond is required for additional concrete or where a bonded surface coating such as paint, tile, resilient flooring, and similar materials are to be applied.

.10 Curing Plan:

.1 Detailed curing plan containing (at minimum) the duration of curing, the manner in which the surface will be kept moist, type of curing material, and provisions to address potential problems (for example, high winds or extreme weather conditions) shall be prepared by the Contractor and submitted for review by the Consultant as part of the Work plan requested in subsection 1.6, above.

3.6 FINISHING

.1 Treat and finish exposed formed surfaces in accordance with CSA A23.1.

.2 Grout tie holes in concrete flush to the concrete surface. Grout with finishing cement mortar using the same sand and cement as used in the concrete.

.3 Pack grout into place to fill the tie hole and finish to match the adjacent concrete surface.

.4 After the removal of forms, strike off projections, and fill honeycombing and defects in accordance with CSA A23.1/A23.2.

.5 Refer to honeycombed areas for inspection and designation as structural or non-structural and repair as directed by the Consultant.

.6 Floor finish classification: Class A in accordance with Table 22 of CSA A23.1.

.7 Except where indicated otherwise in the Room Finish Schedule on the Contract Drawings or elsewhere in the Contract Documents, follow the follow finishing schedule:

AREA	**Type of Finish**
Wall Surfaces – Exterior:	
1. Above grade/exposed (above a point 150mm below finish grade)	Number 6 Finish
2. Above grade/covered with brick veneer or other finish material	Number 5 Finish
3. Backfilled (below a point 150mm below finish grade)	Number 4 Finish
Slabs – Upper Surface:	
4. Firing Range floor slab and Shipping & Receiving floor slab	Number 2 Finish
5. Exterior roof slab/covered with roofing or waterproofing material	Number 1 Finish
6. Other exterior slabs	Number 2 Finish
7. Stairs and landings	Number 3 Finish
8. Top of interior buildings slabs	Number 2 Finish
9. Top of interior slabs to receive mortar setting bed for tile	Number 7 Finish
10. Top of interior slabs to receive resilient flooring or carpet, chemical resistant coating, special flooring, tiles on thin set mortar	Number 2 Finish

11. Equipment bases	Number 2 Finish
12. Where shake on hardener is applied	Number 2 Finish

.8 Finish type other than those indicated in the Room Finish Schedule on the Contract Drawings or elsewhere in the Contract Documents shall be as follows:

.1 Number 1 Finish (Wood Float):

.1 After screeding by accepted method to obtain required floor tolerances, work the surface by means of a wood float in such a manner that after concrete has hardened, no portion of surface shows a variation of more than that specified.

.2 Number 2 Finish (Trowelled):

.1 After screeding and compaction with a wooden float, bring the surface to a smooth level and dense finish free from trowel marks, ridges and depressions by means of steel trowels operated either by hand or by mechanical means.

.2 Do not sprinkle dry cement or sand on the surface during the trowelling process.

.3 Maintain ambient temperature at a minimum of 10°C, when steel trowelling is in progress.

.3 Number 3 Finish (Broomed):

.1 Before the floated surface has fully hardened, brush the surface with a stiff broom in one direction to leave a rough surface.

.4 Number 4 Finish (Formed):

.1 As soon as forms have been removed and directions given by the Consultant, remove projections and fill honeycombing and defects.

.5 Number 5 Finish (Smooth Formed):

.1 As soon as forms have been removed and directions given by the Consultant, patch formwork tie holes, grind off projections, irregularities and rough spots, patch surface defective areas and repair rough spots. Provide a smooth uniform appearance

.6 Number 6 Finish (Rubbed):

.1 As soon as forms have been removed and holes pointed, rub surface with an abrasive rubbing brick until form marks and blemishes are removed and the surface is smooth and of uniform texture and colour.

.2 Do not remove from a larger surface than can be rubbed to fine finish within 6 hours.

.7 Number 7 Finish (Floor to Receive Bonded Topping, Screed, Grout, or Porcelain Tile):

.1 Strike off and screed the concrete base slab to a level below the final floor surface equal to the specified thickness of the finish course as shown on the Drawings.

.2 Float the surface.

.3 Wire broom the surface to make 6mm deep grooves at approximately 20mm centres, running in one direction.

.9 Where the schedule of finishes requires painting, prepare surfaces for painting as specified in Section 09 90 00.

.10 Surface Hardener:
- .1 In area(s) indicated to receive surface hardener, power screed the floor slab and float.
- .2 Over freshly floated concrete apply surface hardener in accordance with the manufacturer's printed instructions.
- .3 Distribute evenly, do not throw hardener.
- .4 Float between applications of hardener and after second hardener application with power floats.
- .5 Machine trowel to smooth, level, and dense surface of uniform colour, free from trowel marks, ridges, pinholes, and other defects.
- .6 Have the manufacturer's representative on Site within 24 hours when requested by the Consultant.

.11 Ensure that the concrete finish is compatible with specified traffic topping or other applied finish.

.12 Production of smooth surfaces by means of cement plaster is not permitted

3.7 CONSTRUCTION TOLERANCE

.1 Concrete tolerances shall be in accordance with CSA A23.1/A23.2 clause 6.4 - Construction Tolerances for Cast-in-Place Concrete, and subsection 1.5 – Quality Assurance, above.

3.8 FIELD QUALITY CONTROL

.1 Site tests: Conduct tests as follows in accordance with CSA A23.1/A23 and submit results as described in subsection 1.6 – Submittals, above.
- .1 Concrete pours.
- .2 Slump.
- .3 Air content.
- .4 Compressive strength at 7 and 28 Days.
- .5 Chloride ion content penetrability (for exposure class C-1 concrete).
- .6 Air and concrete temperature.

.2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Consultant for review in accordance with CSA A23.1/A23.2.
- .1 Ensure testing laboratory is certified in accordance with CSA A283.

.3 Ensure test results are distributed for discussion at the pre-pouring concrete meeting between the testing laboratory and Consultant.

.4 The Consultant will take additional test cylinders during cold weather concreting. Cure cylinders on Site under the same conditions as concrete which they represent.

.5 Non-Destructive Methods for Testing Concrete: in accordance with CSA A23.1/A23.2.

.6 Inspection or testing by the Consultant will not augment or replace the Contractor’s quality control requirements nor relieve Contractor of any of its responsibilities under the Contract.

3.9 LOADING OF STRUCTURE

.1 Do not load any portion of structure prior to achieving 70% of specified strength and only with the acceptance of the Consultant.

.2 Removal of forms prior to the minimum required curing period does not remove the Contractor's obligation to cure and protect the exposed concrete for the minimum required time periods specified. Refer to subsection 3.5 of this Section above.

3.10 REPAIRING SURFACE CRACKS IN CONCRETE

.1 After concrete has set for a minimum of 28 Days, and before a maximum of 125 Days, examine surfaces carefully for cracks.

.2 Rout cracks larger than 0.3mm at the discretion of the Consultant.

.3 Fill cracks with non-shrink grout.

.4 Match the surface to existing surfaces in quality, texture, colour, and elevation.

3.11 REPAIR OF TEMPERATURE AND SHRINKAGE INDUCED CRACKS

.1 Repair cracks in the completed structures employing a suitable polyurethane injection technique to make such cracks completely watertight after repair.

.2 Remove surface injection materials following the completion of the Work and finish the affected areas to match the surrounding concrete.

3.12 INJECTION OF CRACKS – POLYURETHANE GROUT

.1 Use materials in accordance with the manufacturer's printed instructions.

.2 Clean and prepare cracked areas in accordance with the manufacturer's recommendations.

.3 Inject polyurethane grout into cracks in accordance with the manufacturer's written instructions.

.4 Commence injection at the lowest injector on a vertical face and at one end on a horizontal surface. Continue injection until pure uncontaminated material flows out from adjacent injectors. Cap the injectors and proceed to adjacent injectors until all injectors have been filled.

.5 Upon completion, remove injectors and surface sealer. Thoroughly clean the concrete surfaces of excess grout material. Finish the surface to match the surrounding concrete.

.6 Patch injection holes.

3.13 PATCHING

.1 Carry out patching as specified in CSA A23.1/A23.2.

.2 Make good temporary openings left in concrete for pipes, conduits, ducts, shoring, and other Work during construction.

.3 Reinforce with welded wire fabric, as required, and finish to match the surrounding work.

3.14 SEALANT APPLICATION

.1 Do not fill joints sooner than 30 Days after concrete pours.

.2 Comply with the manufacturer’s printed instructions and curing and saw-cutting requirements.

.3 Execute joint sealing during cool, dry ambient conditions when the slab is in a contracted state to minimize future joint separation at sealant filled joints.

.4 Fill sawn joints in concrete slabs full depth with saw-cut joint sealant.

.5 Seal over pre-moulded joint filler with joint sealant.

.6 Comply with the sealant Manufacturer's primer, application, and temperature requirements. Mask floor to edge of joints and fill joint with sealant.

.7 After initial set, prime sealant surface and refill joints with sealant as required to produce a slightly convex joint surface.

3.15 CLEANING

.1 Cleaning:
- .1 Promptly as the Work proceeds and upon completion, clean-up and remove from the site, the rubbish and surplus material resulting from the Work of this Section.
- .2 Leave the Work area clean at the end of each Day.
- .3 Final Cleaning: upon completion, remove surplus materials, rubbish, tools and equipment.

.2 Waste Management:
- .1 Prepare a Construction Waste Management plan in accordance with Section 01 74 00.
- .2 Separate waste materials for reuse and recycling.
- .3 Divert unused concrete materials from landfill to local quarry or facility after receipt of written approval from Consultant.
- .4 Provide an appropriate area on Site where concrete trucks can be safely washed.
- .5 Divert unused admixtures and additive materials (pigments, fibres) from landfill to an official hazardous material collections site as approved by Consultant.
- .6 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.
- .7 Prevent admixtures and additive materials from entering drinking water supplies or streams.
- .8 Using appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal.
- .9 Dispose of waste in accordance with applicable local, provincial and national regulations.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes supply and installation of unit masonry assemblies consisting of the following:
- .1 Veneer Brick
- .2 Concrete Masonry Units (CMUs)
- .3 Mortar, and Grout
- .4 Reinforcing steel
- .5 Masonry joint reinforcement
- .6 Ties and anchors
- .7 Embedded flashing
- .8 Miscellaneous masonry accessories

1.3 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standard.

.2 American Concrete Institute: (ACI):
- .1 ACI 530.1/ASCE 6/TMS 602, Commentary on Specification for Masonry Structures

.3 Brick Institute Association (BIA)
- .1 BIA Technical Notes 20, Cleaning Brickwork
- .2 BIA Technical Notes 23A - Efflorescence, Causes and Prevention

.4 Canadian Standards Association (CSA):
- .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 CAN/CSA A371, Masonry Construction for Buildings
- .5 CSA S304.1, Design of Masonry Structures
- .6 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction

.5 American Society for Testing of Materials (ASTM):
- .1 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .2 ASTM A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .3 ASTM A496/A496M, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
- .4 ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts.
- .5 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.6 ASTM A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
.7 ASTM C67, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
.8 ASTM C207, Standard Specification for Hydrated Lime for Masonry Purposes.
.9 ASTM C270, Standard Specification for Mortar for Unit Masonry.
.10 ASTM C494, Standard Specification for Chemical Admixtures for Concrete.
.11 ASTM E488/E488M, Standard Test Methods for Strength of Anchors in Concrete Elements.
.12 ASTM E514/E514M, Standard Test Method for Water Penetration and Leakage Through Masonry.
.13 ASTM E2556/E2556M, Standard Specification for Vapour Permeable Flexible Sheet Water Resistive Barriers Intended for Mechanical Attachment.
.14 ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
.15 ASTM F594, Standard Specification for Stainless Steel Nuts.

.6 Canadian Concrete Masonry Producer Association (CCMPA):
.1 CCMPA Metric Technical Manual.

.7 Underwriters Laboratories of Canada (ULC):
.1 ULC List of Equipment and Materials for Fire Rated Construction.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Construction Conference: Arrange a site meeting attended by the Contractor's Superintendent, the Sub-Contractor's representative and Foreman for this project, the Consultant, materials Supplier(s), and other relevant personal before commencement of work for this Section; agenda for meeting will include; but not be limited to, the following:
.1 Confirmation of Specifications and details for the project.
.2 Required mortar, grout and concrete testing, batch control and grouting procedures.
.3 Installation requirements of air/vapour membranes and insulation and coordination with other components of the Work.
.4 Confirmation of cavity compartmentalization and drainage requirements.
.5 Confirmation of appearance of exposed block lintels.
.6 Confirmation of reinforcement at corners and wall intersections.
.7 Coordination of interior and exterior crack control measures.
.8 Confirmation of trowelled or tooled joints to concealed and exposed masonry faces.
.9 Confirmation of methods for keeping mortar out of cavity space.
.10 Confirmation of methods for controlling efflorescence during construction.
.11 Confirmation of membranes and membrane flashing materials and details used for construction.
.12 Review of submitted masonry unit samples.
.13 Review of hot and cold weather requirements.

.2 Coordination: Coordinate components of the work of this Section with work performed by other Sections including but not limited to, the following:
- .1 Rain Screen Wall Construction:
  - .1 Masonry veneer forms a part of the exterior rain screen and protective facing.
  - .2 Construct assembly to allow for ventilation and drainage of the voids between the veneer.
  - .3 Maintain thermal, vapour and moisture barrier continuity of existing wall assembly.
- .2 Steel Support Angles and Brackets:
  - .1 Coordinate requirements for structural steel support angles and brackets supplied and installed onto the building structure in accordance with the Drawings and Section 05 50 00.
  - .2 Provide requirements for supply of loose steel lintels and shelf angles installed by this section to Section 05 50 00.
- .3 Masonry Anchors:
  - .1 Coordinate supply of anchor sections connecting to structural frame.
  - .2 Include additional products for coordination furnished, but not installed, under this Section.
- .4 Sheet Metal Flashings and Trim:
  - .1 Coordinate installation of prefinished sheet metal through flashings with Section 07 62 00 .
  - .2 Coordinate installation of continuous aluminum flashings with work of affected components.

1.5 SUBMITTALS

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

.2 Samples: Submit samples of the following: Concrete block, mortar, masonry reinforcement, ties and anchors, damp course/thru-wall flashing and adhesive, metal drip flashing, mortar dropping control device and weepholes for Consultant's approval before commencing work of this Section.

.3 Shop Drawings: Submit shop drawings indicating the following:
- .1 Indicate sizes, profiles, coursing, and locations of special shapes for concrete masonry units and stone masonry cladding.
- .2 Indicate sizes, profiles, and locations of each stone trim unit required.
- .3 Detail corner units, end dam units, and other special applications for fabricated flashings.

.4 Samples for Verification: Submit samples for verification for each type and colour of the following:
- .1 Decorative stone masonry cladding units, in the form of small scale units.

.5 Informational Submittals: Provide the following submittals when requested by the Consultant:
- .1 Submit ULC Assembly Listings and Materials cut sheets for fire rated assemblies as follows:
  - .1 Not later than 30 working days following Award of Contract, submit copies of ULC Assembly and Materials Listing for

indicating ULC Number and how assembly meets the rating criteria for assemblies listed on drawings or meets requirements of Supplementary Standard SB-3 of Ontario Building Code.

.2 Use the same system and material as would be required for a tested assembly for the project; ULC Listings are tested with the specific materials indicated; substitutions will not be permitted unless evidence of equivalency is confirmed.

.3 Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site; include manufacturer's printed instructions for installation.

.6 Certificates: Submit statements of material properties indicating compliance with specified requirements for each type and size of the following:

.1 Masonry Units:

.1 Include material test reports substantiating compliance with requirements.

.2 Include ULC Listings for fire resistance rated materials and construction equivalent to assemblies with indicated on Drawings indicating fire resistance ratings.

.2 Cementitious Materials:

.1 Include brand, type, and name of manufacturer for site mixed mortar materials.

.2 Include description of type and proportions of ingredients for pre-blended, dry mortar mixes.

.3 Include description of type and proportions of ingredients for grout mixes.

.3 Accessories:

.1 Reinforcing bars.

.2 Joint reinforcement.

.3 Anchors, ties, and metal accessories.

.4 Site Quality Control Submissions: Submit detailed description of methods, materials, and equipment used in accordance with cold or hot weather requirements; and proposed unit masonry cleaning techniques.

1.6 SITE CONDITIONS

.1 Protection of Masonry: Protect masonry and other work from marking and other damage and as follows:

.1 Cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work during construction until permanent flashings and membranes are completed.

.2 Cover partially completed masonry when construction is not in progress to prevent wetting of inside wythes of construction and contribution to efflorescence.

.3 Extend cover a minimum of 610mm (24”) down both sides and hold cover securely in place.

.4 Secure cover a minimum of 610mm (24”) down face next to un-constructed wythe and hold cover in place where 1 wythe of multi-wythe masonry walls is completed in advance of other wythes.

.5 Provide adequate bracing for masonry during construction and until permanent lateral supports are in place.

.6 Do not apply uniform floor or roof loads for a minimum of 12 hours and concentrated loads for a minimum of 3 days after building masonry walls or columns.

.2 Cold Weather Protection:

.1 Keep masonry materials completely free from ice and frost. Use approved smokeless heaters. Do not use scorched sand. Do not use salts, admixtures or antifreezes.

.3 Conform to the following construction requirements:

AIR TEMPERATURE	HEATING OF MATERIALS	PROTECTION
Above 5°C	Normal masonry procedures	Cover walls and materials
Below 5°C	Heating mixing water. Maintain mortar temperatures between 5°C and 50°C until placed	Cover walls and materials to prevent wetting and freezing.
Below 0°C	In addition to above heat sand. Thaw frozen sand and frozen wet masonry units before use.	With wind velocities over 35km/h provide windbreaks during the workday and cover walls and materials at the end of each workday to prevent wetting and freezing. Maintain masonry above 0°C by using auxiliary heat or insulated blankets for 16 hours after laying masonry units.
Below -6°C	In addition to above heat dry masonry units to -6°C	Provide enclosure and supply sufficient heat to maintain masonry enclosure above 0°C for 24 hours after laying masonry units.

.4 Hot Weather Requirements:

.1 Comply with hot weather construction requirements contained in reviewed submittals.

.2 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

.3 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.

1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Delivery and Acceptance Requirements: Deliver pre-blended, dry mortar mix in moisture resistant containers designed for lifting and emptying into dispensing silo; store dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

.2 Storage and Handling Requirements: Store masonry units on elevated platforms in a dry location and as follows:

- .1 Stack materials on floors of building so that structural design loads are not exceeded; coordinate with Consultant.
- .2 Cover tops and sides of stacks with waterproof sheeting securely tied to pallets if units are not stored in an enclosed location. Do not install masonry units that become wet until they are dry.
- .3 Store cementitious materials on elevated platforms, under cover, and in a dry location; do not use cementitious materials that have become wet or damp.
- .4 Store aggregates where grading and other required characteristics can be maintained; store to prevent contamination by substances deleterious to performance and appearance.
- .5 Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements listed in this Section, Manufacturers listed as offering products may be incorporated into the Work; alternates may be considered by the Consultant when submitted by the Inquiry Deadline indicated in the Bid Documents.

.2 Manufacturer all exposed masonry by one Manufacturer to provide uniform in colour, shade and texture.

2.2 BRICK VENEER UNITS

.1 Burned Clay Brick: Manufactured in accordance with CAN/CSA A82, and as follows:

- .1 Grade: Exterior Grade (EG).
- .2 Size, Colour and Texture: 4” Face brick matching colour range, texture, and size of existing adjacent brickwork.

.2 Special Shapes:

- .1 Provide units without cores or frogs and with exposed surfaces finished for ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces.
- .2 Provide special shapes for applications where stretcher units cannot accommodate special conditions, including at corners, movement joints, bond beams, sashes, and lintels.

.3 Provide special shapes for applications requiring brick of size, form, colour, and texture on exposed surfaces that cannot be produced by sawing.

.4 Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

2.3 CONCRETE MASONRY UNITS

.1 Standard concrete blocks shall be autoclave or bubble cure process, high pressure steam cured, modular, conforming to CSA A165, with lineal shrinkage and moisture movement not to exceed 0.035% and shall be as follows;
- .1 Classification: S/15/A/M, 75% solid for all locations where structural members bear on concrete block.
- .2 H/15/A/M, for all other block work.
- .3 Size: Modular imperial to sizes indicated on Drawings.
- .4 Special shapes:
  - .1 Provide square units for exposed corners.
  - .2 Provide purpose made shapes for lintels and bond beams.
  - .3 Provide additional special shapes required for project.
  - .4 Manufacture special shapes at same time and with the same batch as standard concrete block to be used.

.2 Use lightweight concrete masonry units, for interior walls, unless indicated otherwise: H/15/D/M for hollow units and SS/15/D/M for solid units.

.3 Fire Resistant Concrete Masonry Units:
- .1 CAN/CSA-A165 Series, same classification as non-rated block units except aggregate used in units and equivalent thickness of units to comply with applicable Code for fire-resistance ratings indicated. For fire rated walls requiring a fire-resistance rating of 3 hours or greater, use ULC certified units.

2.4 MORTAR MATERIALS

.1 Mortar materials shall conform to CSA A179.

.2 Water: Potable (clean, exempt of ice, oils, acid, alkalis, organic matter, sediments or any other harmful matter). CSA A179.

.3 Aggregate:
- .1 CSA A179.
- .2 Use same brands of materials and source of aggregate for entire project.
- .3 Use washed aggregate consisting of natural sand or crushed stone for mortar that is exposed to view.

.4 Cement: Normal portland, in accordance with CSA A3000, Type GU.

.5 Grout: In accordance with CSA A179, Table 3.

.6 Non-Shrink Grout: Premixed, high strength, maximum bearing, impact resistant, non-shrink non-metallic aggregate grout having minimum 55 MPa 28 day compressive strength and conforms to ASTM C939 and ASTM C1107/C1107M, Sika Grout 212 HP by Sika Canada Inc.

.7 Hydrated Lime: ASTM C207, Type S.

.8 Cold Weather Admixture:
.1 Non-chloride, non-corrosive, accelerating admixture in accordance with CSA A179 and ASTM C494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
.2 Acceptable Materials:
.1 Morset by GCP Applied Technologist.
.2 MasterSet AC 534 by Master Builders.

2.5 MORTAR MIXES

.1 Mixing:
.1 Prepare and mix mortar materials under strict supervision and in small batches for immediate use only. Mix proprietary mortars in strict accordance with CSA A179. Do not use re-tempered mortars for coloured mortars.

.2 For Masonry Below Grade and In Contact With Earth:
.1 Use premixed silo or bagged Type 'S' masonry cement mortar having minimum compressive strength of 8.5 MPa at 28 days, jobsite tested.

.3 For Exterior Wythe of Cavity/Composite Walls (non load-bearing, above grade):
.1 Use Type 'N', 1:1:6 pre-mixed, pre-coloured, Portland cement/lime/sand mortar, Betomix Plus by Daubois Inc., or by Maxi-Mix silo. Use non-staining "white" cement where required to achieve colour as selected later by the Consultant.

.4 Interior Reinforced or Non-Reinforced Block Walls:
.1 Use Type 'S', premixed Bloc Mix by Daubios Inc., or approved alternate by Maxi-Mix.

.5 For All Other Masonry:
.1 Use Type 'N', premixed silo or bagged masonry mortar having a minimum compressive strength of 3.5 MPa at 28 days, jobsite tested as per property specification, Table 6, CSA A179.

2.6 MASONRY REINFORCEMENT, TIES AND ANCHORS

.1 Masonry Joint Reinforcement: In accordance with to CSA A371 and ASTM A496/A496M, with corrosion protection in accordance with CSA S304.1 and CSA A370, and as follows:
.1 Interior Walls: Hot dip galvanized, carbon steel.
.2 Exterior Walls: Stainless steel.
.3 Lengths: A minimum of 3000mm (10’) with prefabricated corner and tee units.

.2 Connectors: In accordance with to CSA A370 and CSA S304.1 with hot dip galvanized finish.

.3 Single Wythe Masonry Joint Reinforcement: Either ladder or truss type with single pair of side rods.

.4 Ties and anchors specified in this Section shall be designed in accordance with CSA A370 for non-conventional masonry connectors as follows:

.1 Deflection: Maximum 1.6mm (1/16") including free play, when acted upon by a lateral load of 0.45 kN, in all possible positions of adjustment.
.2 Positive restraint at position of maximum adjustment.
.3 Free play of multi-component ties maximum 0.8mm (1/32") when assembled in all possible configurations.
.4 Anchors shall allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall.

.5 Masonry Unit Veneer/Concrete Masonry Unit Substrate Tie Systems:
.1 Face of Masonry Mount:
.1 Backer Plate: Fabricated from stainless steel meeting requirements of CSA A370 and ASTM A1011/A1011M; designed to transfer wind loads to steel stud framing; length to suit total cavity, insulation and sheathing thickness, as detailed on Drawings.
.2 Ties: Wire ties fabricated from stainless steel wire in accordance with CSA G30.18; length to allow for cavity width and to extend minimum 50mm (2") into masonry unit joint.
.3 Fasteners: Self tapping metal screws to metal stud backup as recommended by tie manufacturer consisting of close tolerance bits for use in percussion drills and hammer driven anchors with pullout strengths of 3.75 kN for hollow concrete masonry unit with a 1" embedment.
.4 Acceptable Materials:
.1 Rap-Tie System by Fero Holdings Ltd.
.2 BL-407 by Blok-Lok

.6 Lateral Partition Supports (Top of Wall Anchors):
.1 Angle Support: Fabricated from 3mm (1/8") core metal thickness angled steel plate having 75mm (3") long legs fastened to deck structure to allow vertical movement of masonry assembly; hot dip galvanized; coordinate with Section 07 84 00 for firestopping insulation and smoke seals.
.2 Plate Support: Fabricated from 3mm (1/8") core metal thickness stainless steel plate with 9.5mm (3/8") diameter metal 150mm (6") long welded to plate having closed end plastic tube fitted over rod that allows rod to move in and out of tube.
.3 Post Installed Anchors: Provide chemical anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit masonry and equal to four times the load imposed when installed in concrete when tested in accordance with ASTM E488/E488M conducted by a qualified independent testing agency, and as follows:
.1 Indoor Locations: Carbon-steel components zinc-plated in accordance with ASTM B633, Class Fe/Zn 5.
.2 Outdoor and High Humidity Locations: Alloy Group 1 or 2 stainless steel bolts complying with ASTM F593 and nuts complying with ASTM F594.
.3 Fastening into Solid Concrete or Solidly Grouted Installation: Two component, injectable adhesive specifically manufactured for use in installing dowels or threaded anchor rods and inserts into new

or existing concrete or grout. Basis-of-Design Materials: HIT HY150 System by Hilti Inc., no substitutions accepted.

.4 Fastening Trough Hollow Wall Installation: Two component, injectable adhesive specifically manufactured for use in installing dowels or threaded anchor rods and inserts, with cylindrical mesh screen tube into new or existing masonry cavity wall. Basis-of-Design Materials: HIT HY20 System by Hilti Inc., no substitutions accepted.

.7 Galvanizing for Masonry Reinforcement, Ties and Anchors:

.1 Hot Dip Hardware and Bolts: In accordance with ASTM A153/A153M, Class B-2 regardless of location.

.2 Hot Dip Sheet Steel: In accordance with ASTM A653/A653M, Coating Designation Z600, regardless of location.

.3 Structural Shapes and Pipes: In accordance with ASTM A123/A123, Grade 85, regardless of location.

2.7 WEEPHOLES

.1 PVC 'T' shaped brick vents by Goodco Limited, or cadmium plated airplane type Weep Holes-343 by Blok-Lok Limited, set 813mm (32") O.C. in the following locations:

.1 Bottom course of exterior masonry units throughout;

.2 Top courses of exterior masonry units throughout;

.3 Exterior masonry units resting on lintels and intermediate angles.

2.8 EMBEDDED FLASHING MATERIAL

.1 Flexible Flashing Membrane:

.1 Self adhering rubberized asphalt flashing; non-extruding composite flashing membrane compatible with air and vapour membrane; consisting of pliable, adhesive rubberized asphalt compound, bonded to a high density, cross laminated polyethylene film to produce an overall thickness of a minimum of 0.8mm (1/32”) and specifically manufactured for use as a through wall flashing and damp course membrane, and as follows:

.1 Acceptable Materials:

.1 Blueskin TWF by Henry Company.

.2 Perm-A-Barrier 4000 Wall Flashing by GCP Applied Technologies.

.3 Sopraseal Stick 1100HT by Soprema.

.2 Adhesives, Primers, and Seam Tapes for Flashings: Flashing Manufacturer's standard products or products recommended by flashing Manufacturer for bonding flashing sheets to each other and to substrates.

.2 Metal Flashing: Provide metal flashing materials in accordance with Section 07 62 00, and as follows:

.1 Fabricate through wall flashing with snap lock receiver on exterior face to receive counter flashing.

.2 Fabricate through wall flashing with drip edge by extending flashing 13mm (1/2”) out from wall, with outer edge bent down 30° and hemmed.

.3 Fabricate through wall flashing with sealant stop by bending metal back on itself 19mm (3/4") at exterior face of wall and down into joint 9.5mm (3/8") to form a stop for retaining sealant backer rod.

.4 Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending a minimum of 75mm (3") into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam; form hem on upper surface of metal so that completed seam will shed water.

.5 Fabricate metal drip edges for flexible flashings from stainless steel; extend a minimum of 75mm (3") into wall and 13mm (1/2") out from wall, with outer edge bent down 30° and hemmed.

2.9 MORTAR DROPPING CONTROL DEVICES

.1 Mortar Dropping Control Devices:

.1 High density, polyethylene or nylon woven mesh type mortar dropping control devices with trapezoidal "zigzag" shaped top edge, designed to allow moisture/water to flow/drain downward in cavity/collar joints to the weepholes, thicknesses to suit cavies and collar joints, 'The Mortar Net' by Mortar Net USA Ltd., and distributed by JV Building Supply, division of Consolidated Materials Corporation, or approved equal.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

.1 Packing Insulation: Loose, mineral wool insulation, 16kg/m^3 (1.0lbs./ft^3) density and conforming to CAN/CGSB-51.11.

.2 Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation 2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

.1 Products: Subject to compliance with the requirements of this Section, provide:

.1 RS Series – Rubber Control Joints by Hohmann & Barnard, Inc.

.3 Firestopping: As specified under Section 07 84 00.

.4 Sealants: As specified under Section 07 92 00, and as follows:

.1 Vertical Sealant: Colour to match brick.

.2 Horizontal Sealant: Colour to match mortar.

.5 Maintenance Cleaners: Manufacturer's recommended maintenance cleaners formulated for use with anti-graffiti coating used on project.

.6 Support Angle:

.1 Hot dip galvanized 458 g/m□/side in accordance with CSA A370 and ASTM A153/A153M.

.7 Fasteners: Galvanized fasteners meeting the requirements of ASTM A325, and as recommended by Manufacturer.

.8 Joint Filler:
.1 Compressible Filler: Pre-moulded filler strips in accordance with ASTM D1056, Grade 2A1; compressible up to 35%; of width and thickness indicated; formulated from neoprene, urethane or PVC.

.9 Building Paper: No.15 asphalt saturated, organic felt in accordance with CSA A123.3.

2.11 VAPOUR BARRIER

.1 To match vapour barrier in existing wall assembly.

3 Execution

3.1 EXAMINATION

.1 Examine conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
.1 Prepare written report listing conditions detrimental to performance of work and submit to the Consultant.
.2 Verify that foundations are within tolerances specified.
.3 Verify that reinforcing dowels are properly placed.

.2 Examine rough-in and built-in construction for piping systems to verify actual locations of piping connections before installation of unit masonry.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION - GENERAL

.1 Thickness: Build cavity walls and other masonry construction to full thickness shown on Drawings.

.2 Use full size units without cutting except as follows:
.1 Cut units with motor driven saws if cutting is required to provide a continuous pattern or to fit adjoining construction.
.2 Provide clean, sharp, un-chipped edges.
.3 Allow units to dry before laying unless wetting of units is specified.
.4 Install cut units with cut surfaces and cut edges concealed where possible; obtain Consultant’s acceptance where cut edges must be exposed.

.3 Select and arrange units for exposed unit masonry to produce a uniform blend of colours and textures; mix units by drawing units diagonally down multiple rows from at least three different pallets as masonry units are placed. "Exposed" means visible in complete work, unpainted and painted.
.1 Large variations in colour or texture between adjacent blocks of material will cause the Consultant to reject the installation, and the Installer to rebuild the assembly at no additional cost to Contract.

.4 Wet masonry before laying when recommended by manufacturer; allow units to absorb water so they are damp but not wet at time of laying.

.5 Maintain dimensions, lines and levels.

.6 Keep exposed faces free from stains, chips and cracks. Keep tolerance in plane of 3mm in 2440mm (1/8" in 8'-0"). Do not use chipped, cracked or deformed units in exposed work.

.7 Buttering corners of units, throwing mortar droppings into joints, will not be permitted. Do not shift or tap units after mortar has taken initial set, where adjustments must be made after mortar has started to set, remove mortar and replace with fresh supply.

3.3 LAYING MASONRY WALLS

.1 Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement type joints, returns, and offsets; avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

.2 Bond Pattern for Exposed Masonry: Unless otherwise indicated in this Section or on the Drawings or to match existing bond pattern, lay exposed masonry in running bond. Do not use units with less than 100mm (4") horizontal face dimensions at corners or jambs; lay masonry in running bond where not otherwise indicated.

.3 Lay concealed masonry with all units in a wythe in running bond, and as follows:
- .1 Bond and interlock each course of each wythe at corners.
- .2 Do not use units with less than nominal 100mm (4") horizontal face dimensions at corners or jambs.

.4 Stopping and Resuming Work:
- .1 Stop work by racking back units in each course from those in course below; do not tooth.
- .2 Clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry when resuming work.

.5 Built-In Work:
- .1 Build in items specified in this and other Sections as construction progresses.
- .2 Fill in solidly with masonry around built-in items.
- .3 Place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core where built-in items are to be embedded in cores of hollow masonry units.
- .4 Protect built-in items from damage arising from work of this Section.

.6 Grouting and Concrete Core Fills:
- .1 Fill cores in hollow concrete masonry units with grout 610mm (24") under bearing plates, beams, lintels, posts, and similar items.
- .2 Use concrete where indicated, and also for vertical core filling, lintel beams, bond beams and other filled cores where reinforcing steel is indicated.
- .3 Use fine grout where the space being grouted is 50mm (2") or less in its least dimensions; use concrete in all other applications that call for grout.
- .4 Use square end concrete masonry units wherever a full or half concrete masonry unit will receive concrete fill.

.5 Use full mortar bedding of cross webs for cares that are filled.
.6 Fill cores in lifts of 1220mm (4') maximum; provide cleanout openings for lifts in excess of 1220mm (4') where Consultant has accepted larger lifts.
.7 Consolidate core fill during placement by vibration or puddling.
.8 Stop concrete core fill 38mm (1-1/2") below top surface of lift whenever filling will be stopped for more than a 1 hour time duration.
.9 Secure vertical reinforcement in position at top and bottom of core, and a maximum 4' spacing, refer to Drawings for location of vertical reinforcement.
.10 Fill voids solid with mortar so that ties and anchors are set in full mortar bed where masonry walls abut steel or concrete columns.

.7 Build non-load bearing interior partitions full height of storey to underside of solid floor or roof structure above, leaving a gap to allow for structural deflection, and as follows:
.1 Install compressible filler in joint between top of partition and underside of structure above.
.2 Fasten lateral partition supports to structure above and build into top of partition.

3.4 MORTAR BEDDING AND JOINTING

.1 Lay hollow brick as follows:
.1 Face shall be fully bedded in mortar and with head joints of depth equal to bed joints.
.2 Webs fully bedded in mortar in all courses of piers, columns, and pilasters.
.3 Webs fully bedded in mortar in grouted masonry, including starting course on footings.
.4 Entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

.2 Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place; do not deeply furrow bed joints or slush head joints.

.3 Lay block work as follows:
.1 Provide special shapes and sizes as required such as halves, jambs, lintels, solids, corners, semi-solids, etc.
.2 Webs to align plumb over each other with thick ends of webs up. Leave no cells open in exposed work. Reinforce all block.
.3 Minimize cutting block. Cut exposed work with power driven abrasive cutting disc or diamond cutting wheel for flush mounted electrical outlets, grilles, pipes, conduit, etc., leaving 3mm (1/8") maximum clearance.
.4 Do not wet concrete masonry units before or during laying.
.5 Locate corners accurately. Use full bed of mortar for first course. Bed face shells and cross and end web fully in mortar. Stagger joints in every course. Align joints plumb over each other in every other course.
.6 Bond intersecting block walls in alternate courses. Where block abuts concrete, bond each block course with dovetail anchors, ties and dovetail slot. Do not break bond of corridor walls or other walls of exposed units

where partitions intersect and if bonding would show through on intersect with prefabricated intersection masonry reinforcement in each course.

.7 Take special care in erecting block walls to which other Sections will be applying finishes or attaching equipment to ensure tolerances required for work of other Sections can be met with reasonable construction procedures. (e.g., thin-set application of ceramic tile.)

.8 Provide bullnose block at all exposed block corners.

.9 Build block lintels, ensure that lintel jointing coincides with regular bond.

.4 When mortar is "thumbprint" hard, tool all masonry joints (exposed or concealed) concave except at blockwork designated to receive ceramic tile finish which blockwork shall be struck flush. Use sufficient force to press mortar tight against masonry units on both sides of joints. Remove excess material or burrs left after jointing. Use trowel or rub with burlap bag.

.5 Lay all joints 9.5mm (3/8") thick unless otherwise specified or otherwise indicated. Fill all joints solidly with mortar except where specifically designated to be left open.

.6 Stagger joints in every course. Align joints plumb over each other in every other course. Vertical and horizontal joints to be uniform in thickness.

3.5 CAVITY WALL CONSTRUCTION

.1 Repair cavity wall assemblies in stages to permit Consultant to inspect each component prior to installing subsequent work, in the following order:

.1 Interior wythe;

.2 Self adhered flashing membrane;

.3 Vapour and air barriers;

.4 Exterior wythe.

.2 Barrier Membrane Application:

.1 Ensure that surfaces to receive membrane are dry, firm, suitable for bond, and free from loose material, projections, ice, frost, slick, grease, oil or other matter detrimental to bond of the air barrier membrane.

.2 Report surfaces left unacceptable by other trades to the Consultant before commencing installation.

.3 Install all materials in accordance with the manufacturers' printed directions.

.3 Keep cavity space and weep holes clean and free of mortar droppings and other foreign materials.

.4 Bond inner and outer wythes of cavity wall with cavity wall masonry reinforcement at 405mm (16") O.C. vertically. Provide additional reinforcing at openings as specified hereinafter.

.5 Install thru-wall flashings and dampproof course as specified elsewhere in this Section.

.6 Install mortar dropping control devices as specified elsewhere in this Section.

.7 Install weep/vent holes as specified elsewhere in this Section.

.8 Install insulation in cavity walls of type matching existing wall assembly as they are built.

3.6 PARTITIONS (OTHER THAN LOAD-BEARING)

.1 Carry following partitions up through ceiling to structure above, unless noted or specified otherwise; corridor partitions, partitions around staircases and shafts, partitions around washrooms, and any other partitions so indicated on Drawings. Terminate all other partitions at first coursing joint above finished ceiling.

.2 Except around staircases and shafts, terminate through partitions within 19mm (3/4") of structure above, i.e., floor, roof decking depending under which partitions occur, and where such partitions occur directly under and parallel to structural framing carry these partitions up to within 19mm (3/4") of bottom of such structural framing.

.3 Around staircases and shafts, wedge and grout masonry solidly to structure above. Laterally support other partitions as required by building code. Where tops of partitions are exposed to view, lateral supports shall be concealed.

.4 Where walls and partitions are pierced by structural members, ducts or pipes, fill voids with mortar to within 19mm (3/4") of such members flush with wall fins.

.5 Fill spaces between partition and structure, ducts and pipes with compressed glass fibre or mineral wool insulation completely from one side of wall to other.

.6 Where grout fill is specified in steel door frames, use non-shrink grout.

- .1 Brace or fasten frames to prevent the pressure of the grout from deforming the frame members.
- .2 Mix grout to provide a 102mm maximum slump consistency and hand trowel grout into place.
- .3 Do not use grout with thin, pumpable consistency.

3.7 CONTROL JOINTS

.1 Provide vertical through wall control joints 7620mm (25'-0") O.C. maximum (except as otherwise shown or specified) in continuous walls having no openings, intersections or columns. Locate control joints as directed by Consultant.

.2 Locate control joints at high stress concentrations and at points of weakness such as at abrupt changes in work height, wall thickness changes such as at chases and at pilasters and maximum of 3660mm (12'-0") from corners.

.3 Construct joint as detailed and generally as follows:

- .1 Place building paper against end of block on one side of control joint. Extend bond breaker full wall thickness.
- .2 Fill voids between ends of block with mortar to form key and strike back exposed vertical joints 19mm (3/4") deep, install backer rod and caulk in accordance with Section 07 92 00.
- .3 Reinforce joints every third course with two 6mm (1/4") diameter greased smooth rods. Locate rods 32mm (1-1/4") in from faces of block centres on joint running parallel to wall.

3.8 REINFORCEMENT AND REINFORCING TIES

.1 Reinforce all masonry walls with continuous masonry reinforcement in every second block course.

.2 Provide extra reinforcement or reinforcing ties at openings so that first and second courses above and below openings are reinforced. Extend extra reinforcement 610mm (2'-0") beyond opening in each direction.

.3 Anchor new masonry to structural steel to concrete elements, to existing construction at maximum 406mm (16") O.C., vertically in accordance with local building code requirements.

.4 Masonry Veneer/Metal Stud Back-Up System:

- .1 Ensure wire tie spaced maximum 406mm (16") O.C. vertically and stud spacing horizontally.
- .2 Tie wires shall be minimum 4.8mm (3/16") diameter stainless steel wire ties.
- **.3** Embed ties 50mm (2") minimum into the bed joints of masonry veneer.

3.9 FLEXIBLE AND METAL FLASHING

.1 Install damp course/thru-wall flashing with adhesive in accordance with Manufacturer's written instructions, where indicated on Drawings and in absence of any indication in locations as follows:

- .1 First course above new grade line.
- .2 Over exterior lintels and shelf angles.
- .3 Under windowsills.
- .4 Wherever roofs or other exterior, horizontal surfaces intersect masonry walls, immediately above roof flashing or horizontal surface flashing and connect to roof, air barrier flashing strips or flashings.

.2 Install continuous metal drip flashing at all locations where thru-wall flashing occurs at wall face. Accurately mitre metal drip flashings at all inside and outside corners and deburr all sharp edges/corners. Insert metal drip flashing 50mm (2") into masonry joint with drip edge turned down approximately 9.5mm (3/8") to present a neat, straight line appearance. Adhere thru-wall flashing to top surface of metal drip flashings.

.3 Extend damp coursing and flashing through full thickness of walls, carrying material from outside to inside. Then install flashing, using same material as damp course, from outside through thickness of first wythe at same joint as damp course, up one block course in behind air barrier membrane and through the inner wythe for composite wall construction and up face of exterior wallboard 203mm (8") and under air barrier membrane for cavity wall construction.

.4 Lap all joints 150mm (6") and seal with adhesive.

.5 Wrap damp course/thru-wall flashing into inside corners and around outside corners, sealing seams and corners with adhesive/sealant.

.6 At ends of exterior lintels and shelf angles provide "end dams" in damp course/thru-wall flashing by extending damp course/thru-wall flashing up minimum of 150mm (6") and wrapping into inside corners and sealing with adhesive sealant. Adhere "end dam" to adjacent masonry veneer with adhesive.

.7 Inspect damp course/thru-wall flashing for punctures, tears, misaligned seams and the like, apply additional layer of damp course/thru-wall flashing, extending minimum of 150mm (6") around damaged area in all directions.

.8 Trim exposed edges of damp course/thru-wall flashing in a neat, even appearance, removing excess materials projecting beyond edge of support.

.9 Tie in damp course/thru-wall flashing with air barrier membrane to ensure continuity of air barrier in accordance with local building code requirements.

3.10 BUILT-INS

.1 Built-in items provided by other Sections, anchor bolts, sleeves, inserts, loose steel lintels, shelf angles, access panels, and other such items. Built-in items to present neat, rigid, true and plumb installation. Leave wall openings required for ducts, grilles, pipes and other items.

.2 Fill voids between masonry and metal frames with masonry mortar.

3.11 REPOINTING OR TUCKPOINTING

.1 Repoint defective joints as follows:

.1 Cut back joints 13mm (1/2"), taking care not to damage units. Remove dust and loose materials by brushing or by water jet.

.2 If water jet is used, allow excess water to drain before repointing.

.3 Repoint with same mix as original. Pack mortar tightly in thin layers, and tool joints or strike flush as required.

3.12 CLEANING

.1 Keep work clean and free of mortar stains during laying. Allow mortar droppings which adhere to wall to dry out but not set. Then rub with small piece of masonry followed by brushing to remove all traces. On completion of masonry, after mortar is thoroughly set and cured, and defective joints tucked and pointed, clean masonry thoroughly.

.2 Remove mortar with wood paddles and scrapers before wetting. Saturate masonry with clean water and flush off loose mortar and dirt. Clean block work using water, scrubbing brushes and wood paddles only.

END OF SECTION

1 General

1.1 SUMMARY

.1 Unless otherwise specified conform to CSA-S16, Steel Structures for Building - Limit States Design and CAN/CSA-S136, Cold Formed Steel Structural Members.

1.2 RELATED REQUIREMENTS

.1 Section 06 10 00
.2 Section 09 21 16

1.3 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 American Iron and Steel Institute (AISI):
- .1 AISI S201, North American Standard for Cold Formed Steel Framing – Product Data.

.3 Canadian Institute of Steel Construction (CISC):
- .1 CISI - Specification for the Design of Cold-Formed Steel Structural Members, in accordance with CAN/CSA-S136.

.4 American Society for Testing and Materials (ASTM):
- .1 ASTM A153/A123M, Zinc Coating (Hot-Dipped) on Iron and Steel Hardware.
- .2 ASTM A568/A568M, General Requirements for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
- .3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- .4 ASTM C955, Standard Specification for Cold-Formed Steel Structural Framing Members.

.5 American National Standards Institute/American Welding Society:
- .1 ANSI/AWS D1.3, Structural Welding Code - Sheet Steel.

.6 Canadian Standards Association:
- .1 CSA-W47.1, Certification of Companies for Fusion Welding of Steel Structures.
- .2 CSA-W59, Welded Steel Construction (Metal Arc Welding).
- .3 CSA-S16, Design of Steel Structures.
- .4 CAN/CSA-S136, North American Specification for the Design of Cold-Formed Steel Structural Members.

.7 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .2 CAN/CGSB-51.32, Sheathing, Membrane, Breather Type.

.8 Canadian Sheet Steel Building Institute:
- .1 CSSBI 51, Lightweight Steel Framing Design Manual.
- .2 CSSBI 61, Manufacturer Certification Requirements for Cold Formed Steel Framing Members.

1.4 DESIGN CRITERIA

.1 The following metal stud framing are to be designed, supplied and installed as part of this Section:

.1 Metal stud framing designed and installed to withstand the effects of wind loads and earthquake motions in accordance with authorities having jurisdiction.

.2 Unless otherwise specified, conform to CAN/CSA S16.1, Steel Structures for Building - Limit States Design and CAN/CSA S136, Cold Formed Steel Structural Members.

.3 Have work of this Section designed by a Professional Engineer licensed to design structures and registered in the place of Work.

.4 Calculate loads and load factors in accordance with the Ontario Building Code.

.5 Base design on Limit States Design principles using factored loads and resistances.

.6 Determine resistances and resistance factors in accordance with the Ontario Building Code and CSA S136.

.7 Select studs which will deflect under specified lateral loads not more than L/360.

.8 Determine resistance strength and resistance factors in accordance with applicable building code requirements and CAN/CSA S136.

.9 Construct work of this Section to provide for expansion and contraction of components as will be caused by ambient temperature range without causing buckling, failure of joint seals, undue stress on fasteners or other effects detrimental to appearance or performance.

.10 Compute section properties on the basis of the nominal core thickness.

.11 Design bridging to prevent member rotation and member translation perpendicular to the minor axis. Provide for secondary stress affects due to torsion between lines bridging.

.12 Design cold formed metal framing system and size components to withstand wind loads and sway displacement as calculated in accordance with applicable building code. Wind loads at external walls shall include unbalanced external and internal wind pressure, as applicable. Wind loads at internal partition walls shall be determined as the following:

.1 Lateral wind loading, Typical Partitions: Design and install cold-formed metal framing and wall assembly to withstand a minimum inward and outward pressure of 240 Pa normal to the plane of the wall.

.2 Loading wind criteria, Special Partitions: Design and install cold-formed metal framing and wall assembly to withstand the minimum inward and outward pressure of not less than 480 Pa normal to the plane of the wall. This criterion shall apply to the following areas:

.1 Partitions surrounding stairs.

.2 Partitions surrounding plenum and air shafts.

.3 Deflection Criteria: Limit metal framing systems deflection under load to the following:

.1 Deflection, Support Framing Gypsum Board Partitions: Deflection of support framing for gypsum board partition systems shall be limited to L/240 of the span in height, except as otherwise shown or specified.

.2 In areas where room side finish is veneer plaster or ceramic tile, deflection of partitions shall be limited to L/360 of the span in height.

.13 Lateral anchorage / connections to the base structure at top and bottom of cold formed metal wall framing shall be designed to withstand wind and seismic loads as determined in accordance with applicable building code. Self weight used in the seismic calculations shall include the total self weight of the wall assembly, plus additional weight of 0.25 kPa projected over the vertical surface area of the subject wall assembly.

1.5 SUBMITTALS

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

.2 Provide CSSBI 61 certification for manufacturer of cold formed steel framing members.

.3 Shop Drawings:

.1 Prepare and submit shop and erection drawings which conform to the requirements of the CAN/CSA-S16, and as specified herein.

.2 Cold formed metal framing system must have shop drawings prepared by qualified draftsmen, checked by and bearing the seal of a Professional Engineer registered to design structures and practice in the place of Work.

.3 Show the size, spacing and location of connections, attachments, reinforcing and anchorage. Include necessary plans, elevations and details. Indicate size and type of fastening. For weld connections use welding symbols in compliance with AWS and indicate clearly net weld lengths.

.4 Submit typical details of connections, and any special connections for approval before preparation of shop drawings.

.5 Review of shop drawings by the Consultant will not absolve the Contractor from the responsibility of providing materials and equipment to complete and finish work of this Section in accordance with the Drawings. Departures or differences from the referenced drawings shall be approved in writing by the Consultant.

1.6 QUALITY ASSURANCE

.1 Conform to requirements of AISI S201 – North American Standard for Cold Formed Steel Framing – Product Data, CAN/CSA-S16 - Steel Structures for Buildings, and CAN/CSA-S136 - Cold Formed Steel Structural Members.

.2 Work to be executed by firm thoroughly conversant with laws, by-laws and regulations which govern, and capable of workmanship of best grade of modern shop and field practice known to recognized Manufacturer's specializing in this work.

.3 Work shall be executed by workers especially trained and experienced in this type of work. Have a full time, senior, qualified representative at the site to direct the work.

.4 Install system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.

.5 Install system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

.6 Retain a Professional Engineer registered to design structure and practice in the place of Work to perform the following services:
- .1 Design cold-formed metal framing systems.
- .2 Review and stamp shop drawings and any amendments.
- .3 During construction, conduct minimum one site inspection to verify whether the cold formed metal framing installation is completed in accordance with approved shop drawings; provide written site inspection at each inspection visit.
- .4 Upon completion of Work, provide letter of conformance confirming the cold formed metal framing installation is in accordance with design requirements and approved shop drawings.

1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with Construction Progress Schedule and arrange ahead for off-the-ground storage location. Do not load any area beyond the design limits.

.2 Adequately protect steel against rust and damage during manufacturing, delivery and storage.

.3 Store material on planks on a dry area and protect from damage. Make good immediately any damage done, clean scratches and the like, touch-up with specified primer.

2 Products

2.1 MANUFACTURERS

.1 Cold formed metal framing as indicated on Drawings and as specified herein shall be by Manufacturers certified under CSSBI 61 certification program.

2.2 MATERIALS

.1 Framing materials shall conform to the requirements of AISI S201 and CAN/CSA-S136.

.2 Galvanized Sheet Steel:
- .1 Conform to ASTM A653/A653M, Type SS with minimum 50 ksi (340 MPa) yield strength and Z275 designation zinc coating.

.3 Structural Metal Studs:
.1 Galvanized sheet steel formed to channel shape, of minimum gauge, sizes, and section properties to meet design requirements, and conforms to ASTM C955.

.4 Metal Stud Runners/Top and Bottom Tracks:
.1 Galvanized sheet steel formed to channel shape, having same width as studs, with tight fit and solid web, of minimum gauge to meet design requirements, but no less than gauge of metal studs, and conforms to ASTM C955.

.5 Metal Plates, Bridging, Bracing, Gussets and Clips:
.1 Formed from galvanized sheet steel, of gauges, shapes and sizes required to meet design requirements determined for conditions encountered, and of same finish as framing members.

.6 Fastenings:
.1 Self-drilling, Self-tapping Screws, Bolts, Nuts and Washers: Hot-dip galvanized to 1.25 ounce per square foot and conforms to ASTM A153/A153M, Class B3, '12-24 x 7/8 HWH #4STLG' by Hilti Canada, or approved alternate.
.2 Anchorage Devices: Power driven, powder actuated, drilled expansion bolts, or screws with sleeves, as application dictates.
.3 Welding Materials: Conforms to CSA W59.
.4 Electrodes for welding shall have minimum 480 MPa tensile strength series, (E480XXX,E480S-X).

.7 Touch-Up Primer:
.1 Ready mixed, zinc-rich primer, and conforms to CAN/CGSB-1.181, Zinc Clad No.5 Organic Zinc Rich Primer by Sherwin Williams Company of Canada Ltd. or approved equal.

.8 Bituminous Paint: Acid and alkali resistant bituminous isolation coating.

.9 Butyl Tape: Extruded, High grade macro-polyisobutylene tape of width and shore hardness to suit conditions.

.10 Dampproof Course: No.15 asphalt saturated, organic felt in accordance with CSA A123.3.

2.3 FABRICATION

.1 Fit and assemble work in shop where possible. Execute work according to details and reviewed shop drawings.

.2 Take measurements at the building for work which is to fit or be connected to steel, concrete framing or masonry, before commencing fabrication.

.3 Structural metal studs shall have one unreinforced service cut-out centred in the web of the studs and with the centreline of the cut-out a minimum of 455mm (1'-6") from the bottom of the studs. In addition to the above, provide cut-outs for internal bridging as required.
.1 All unreinforced cut-outs shall conform to the following dimension limitations:

ALLOWABLE DIMENSIONS FOR UNREINFORCED CUT-OUTS			
MEMBER DEPTH (MM)	PERPENDICULAR TO THE LENGTH OF THE MEMBER (MM)	PARALLEL TO THE LENGTH OF THE MEMBER (MM)	CENTRE TO CENTRE SPACING (MM)
92	38 MAX.	114 MAX.	610 MIN.
102	38 MAX.	114 MAX.	610 MIN.
≥152	64 MAX.	114 MAX.	610 MIN.

.2 Distance from the centreline of the last unreinforced cut-out to the end of the member to be maximum 305mm.

.4 Provide pre-punched cut-outs in inner top track for anchor clearances so that deflection clearances are not reduced.

.5 Manufacturing tolerances for cold formed steel framing members to conform to requirements in CSSBI 61.

.6 Cutting of cold formed steel framing members shall be by "power saw" or "shear" methods. Cutting by "torch" method shall not be permitted.

.7 Steel thickness, exclusive of coating shall be marked on all cold formed steel framing members by embossing, or by stamping with indelible ink, or by colour coding method.

.8 Gauges and sizes of metal shall be adequate for various conditions.

3 Execution

3.1 EXAMINATION

.1 Verify at site that the work to receive the work of this Section is free of irregularities detrimental to the installation and performance of the work and that it is located correctly and at proper levels before delivery and installation.

.2 Verify that building framing components are ready to receive work.

.3 Beginning of installation means acceptance of existing conditions.

3.2 ERECTION OF STUDS

.1 Install components in strict accordance with Manufacturer's written instructions.

.2 Methods of construction may be either piece by piece (stick-built), or by fabrication into panels (panelized) either on or off site. Handling and lifting of prefabricated panels shall not cause permanent distortion to any member or collateral material.

.3 Cold formed steel framing shall be erected true and plumb within the tolerances specified herein. Temporary bracing shall be employed wherever necessary to withstand all loads to which the structure may be subject during erection and subsequent construction. Temporary bracing shall be left in place as long as required for the safety and integrity of the structure. The Contractor shall ensure that during erection a margin of safety consistent with the requirements of the National Building Code and CAN/CSA-S136 exists in the uncompleted structure.

.4 Erection Tolerances:

.1 For the purposes of erection tolerances, "camber" is defined as the deviation from straightness of a member or any portion of a member with

respect to its major axis and "sweep" is defined as the deviation from straightness of a member or any portion of a member with respect to its minor axis.

.2 For wind bearing studs, out of plumbness shall not exceed 1/500th of the member length. Out of straightness (camber and sweep) shall not exceed 1/1000th of the member length.

.3 For runners/tracks, camber shall not exceed 1/1000th of the member length.

.4 Studs shall seat into top and bottom runners/tracks. The gap between the end of the stud and the web of the runner/track shall not exceed 4mm (5/32") for wind bearing studs.

.5 Where cold formed metal framing is made in prefabricated panels, align adjacent prefabricated panels to provide surface continuity at the interface.

.6 Spacing of studs shall not be more than 3mm (1/8") from the design spacing. The cumulative error in spacing shall not exceed the requirements of the finishing materials.

.5 Align floor and ceiling runners/tracks, locate to wall or partition layout. Secure in place with screws or welding at maximum 610mm (24") O.C. Coordinate installation of sealant with floor and ceiling track.

.6 Place studs to meet design requirements as indicated on approved shop drawings, and not more than 50mm (2") from abutting walls, and at each side of openings. Connect studs to tracks using clips and ties, screws, or welding. Diameter of screws shall be equal to, or exceed the minimum diameter indicated on the reviewed shop drawings. Penetration of screws beyond joined materials shall be not less than three exposed threads. Thread types and drilling capability of screws shall conform to the manufacturer's written recommendations to suit design requirements and conditions. Screws to be covered by sheathing materials shall have "low profile" type heads.

.7 Isolate contact surfaces to prevent electrolysis due to metal contact with masonry, concrete or dissimilar metal surfaces. Use bituminous paint, dampproof paper, butyl tape or other approved means.

.8 Field cutting of cold formed steel framing members shall be by "power saw" or "shear" methods. Cutting by "torch" method shall not be permitted.

.9 Holes that are field cut into cold formed steel framing members shall conform to the dimensional requirements of Table 1, in the CSSBI M50-1987 Manual.

.10 Brace structural metal studs as required to meet design requirements and as indicated on reviewed shop drawings.

.11 Provide continuous dampproof course to underside of bottom runner/track.

.12 Construct corners using minimum of three studs. Double studs at door, window jambs, and wall openings.

.13 Erect studs one-piece full length. Splicing of studs is not permitted.

.14 Erect load bearing studs, brace, and reinforce to develop full strength to meet design requirements.

.15 Refer to Drawings for height of partition framing.

.16 Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

.17 Install intermediate studs above and below openings to match wall stud spacing.

.18 Provide deflection allowance in stud bottom runner/track, directly below horizontal building framing for non-load bearing framing.

.19 Attach cross studs or furring channels to studs for attachment of fixtures anchored to walls. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

.20 Touch-up field welds and damaged galvanized surfaces with two coats of zinc rich touch-up primer.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Supply and install all miscellaneous metal work indicated on Drawings and not included in the work of other Sections in addition to items listed in this Section.

1.3 RELATED REQUIREMENTS

.1 Section 06 10 00
.2 Section 09 21 16
.3 Section 09 90 00
.4 Read carefully all other Sections and review Drawings to determine extent of metal work supplied and installed or installed by others.
.5 Be responsible for co-ordinating this Section with all related Sections.

1.4 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 American Society for Testing and Materials (ASTM):
- .1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
- .2 ASTM A276, Standard Specification for Stainless Steel Bars and Shapes
- .3 ASTM A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- .4 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- .5 ASTM A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip Plate, and Flat Bar
- .6 ASTM C939, Standard Test Method for Flow of Grout for Preplaced Aggregate Concrete (Flow Cone Method)
- .7 ASTM A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with improved Formability, and Ultra-High Strength
- .8 ASTM C1107/C1107M, Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

.3 Canadian Standards Association (CSA):
- .1 CSA G40.20-04/G40.21, General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
- .2 CAN/CSA-G164-M92, Hot Dip Galvanizing or Irregularly Shaped Articles
- .3 CSA-S16, Design of Steel Structures
- .4 CSA-S136, North American Specification for the Design of Cold Formed Steel Structural Members
- .5 CSA W47.1, Certification of Companies for Fusion Welding of Steel

.6 CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum
.7 CSA W59, Welded Steel Construction (Metal Arc Welding)

.4 Canadian General Standards Board (CGSB):
.1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating
.2 CAN/CGSB-51.32, Sheathing, Membrane, Breather Type
.3 CGSB 31-GP-105Ma, Zinc Phosphate Conversion Coatings for Paint Base

.5 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers International (NACE):
.1 SSPC-SP 1, Solvent Cleaning
.2 SSPC-SP 2, Hand Tool Cleaning
.3 SSPC-SP 3, Power Tool Cleaning
.4 SSPC-SP 6/ NACE No. 3, Commercial Blast Cleaning

1.5 QUALITY ASSURANCE

.1 All Codes and Standards referred to in this Specification shall be current editions including all latest revisions and addenda.

.2 Conform to requirements of CSA-S16, Design of Steel Structures and CAN/CSA-S136, Cold Formed Steel Structural Members.

.3 Architectural metals work shall be of the highest architectural quality, free of scratches, pitting, roughness, marring, discolouration, staining and other imperfections.

.4 Work of this Section to be executed by firm thoroughly conversant with laws, by-laws and regulations which govern, and capable of workmanship of best grade of modern shop and field practice known to recognized Manufacturer's specializing in this work.

.5 Work of this Section shall be executed by workers especially trained and experienced in this type of work. Have a full time, senior, qualified representative at the site to direct the work of this Section.

.6 Where required by authorities having jurisdiction, have work of this Section designed by a Professional Engineer licensed to design structures and registered in the Province of the Work.

1.6 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00, bearing stamp or seal and signature of the Professional Engineer responsible for the design of the work of this Section.

.2 Shop Drawings:
.1 Make thorough examination of Drawings and details, determine the intent, extent, and materials, and be fully cognizant of requirements when preparing shop drawings.
.2 Submit shop drawings showing and describing in detail all work of this Section including large scale detail of members and materials, of connection and interfacing with work of other Sections, jointing details,

and of anchorage devices, dimension, gauges, thicknesses, description of materials, metal finishing, as well as other pertinent data and information.

.3 Digital files of design drawings shall not be used in the preparation of shop drawings.

1.7 STORAGE, DELIVERY, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for strategic off the ground, under cover storage locations. Do not load any area beyond the design limits.

.2 Adequately protect and crate all components against damage, dirt, disfigurement and weather during delivery and storage. Damaged materials shall not be used and shall be replaced by approved material.

.3 Cover and protect the work of other Sections in the area of work from damage. Make good all damage to the satisfaction of the Consultant.

.4 Protect the installed work of this Section and on completion the work shall be examined, and damage shall be remedied to the complete satisfaction of the Consultant.

2 Products

2.1 MATERIALS

.1 Structural Steel Sections and Steel Plate: New stock (not weathered or rusted); to conform to CAN/CSA-G40.21, Grade 300W (44W) and Grade 350W (50W) for wide flange shapes.

.2 Hollow Structural Sections (HSS): New stock; to conform to CAN/CSA-G40.21, Grade 350W (50W), Class C, stress relieved.

.3 Sheet Steel (Structural Quality): Conforms to ASTM A1011/A1011M.

.4 Sheet Steel (Commercial Quality): Conforms to ASTM A653/A653M, stretcher levelled, or temper rolled.

.5 Tube: Conforms to ASTM A53.

.6 Galvanized Sheet Steel (Commercial Quality): Galvanized coating G90 (Z275) in accordance with ASTM A653/A653M, minimized spangle, stretch levelled or temper rolled. Specially treat by phosphate conversion process conforming to CGSB 31-GP-105Ma ready to receive prime paint finish.

.7 Steel Pipe: Hot-dip galvanized, zinc coated, welded and seamless type steel pipe conforming to ASTM A53/A53M.

.8 Stainless Steel Sheet, Strip, Plate, and Flat Bars: In accordance with ASTM A666, Type 304.

.9 Stainless Steel Bars and Shapes: In accordance with ASTM A276, Type 304.

.10 Aluminum Plate and Sheet: ASTM B209M, Alloy 6061-T6.

.11 Aluminum Extrusions: ASTM B221M, Alloy 6063-T6.

.12 Non-Shrink Grout: Premixed, high strength, maximum bearing, impact resistant, non-shrink non-metallic aggregate grout having minimum 55 MPa 28 day compressive strength and conforms to ASTM C939 and ASTM C1107/C1107M, MasterFlow 816 by Master Builders Solutions, or Sika Grout 212 HP by Sika Canada Inc.

.13 Galvanizing: All uncoated steel specified to be galvanized shall be galvanized after fabrication by the hot dip process according to CAN/CSA-G164, with minimum coating of 600g/m^2 (2oz./ft^2) Galvanize after all welding is complete. Welding of galvanized material will not be permitted. Specially treat by phosphate conversion process conforming to CGSB 31-GP-105Ma ready to receive prime paint finish.

.14 Primer Paint: CISC/CPMA 2-75.

.15 Bolts, Nuts, Washers: Conforms to ASTM A325.

.16 Welding Materials: Conforms to CSA W59.

.17 Metal Filler: Polyester based type.

.18 Zinc Rich Paint for Touch-up of Galvanized Metals: Ready mixed, zinc-rich primer conforming to CAN/CGSB-1.181, Zinc Clad No. 5 Organic Zinc Rich Primer by Sherwin Williams Company of Canada Ltd. or approved equal.

.19 Refer to Section 09 90 00 for site finish paint requirement.

.20 Bituminous Paint: Acid and alkali resistant bituminous isolation coating.

.21 Butyl Tape: Extruded, High grade macro-polyisobutylene tape of width and shore hardness to suit conditions.

.22 Building Paper: No.15 asphalt saturated, organic felt in accordance with CSA A123.3.

2.2 FABRICATION

.1 Fit and assemble work in shop where possible. Execute work according to details and reviewed shop drawings.

.2 Take measurements at the building for work which is to fit or be connected to steel or concrete before commencing fabrication.

.3 Where shop fabrication is not possible, make trial assembly in shop.

.4 Do all welding in accordance with requirements of CSA W59, CSA W55.3 and CSA W47.1 including all supplements. Weld stainless steel electric arc process. Grind welds smooth and flush with surface of parent metal, where exposed to view and where specifically indicated on Drawings. Welds shall be continuous seam welds unless specified otherwise. Maintain sharp arises.

.5 Fit joints and intersecting members accurately in true planes, square, plumb, straight with tight joints and intersections.

.6 Provide adequate reinforcing, fastenings, anchors, accessories required for fabrication and erection of work of this Section. Such items occurring on or in an exterior wall or slab shall be hot-dip galvanized. Make thread dimensions such that nuts and bolts will fit without rethreading or chasing threads.

.7 Fabricate, drill and tap members to accommodate attachments, anchorage and work of other Sections where located and directed by them.

.8 Exposed steel surfaces shall be smooth and free from imperfections such as warping, buckling, weld marks, burrs, rust and scale.

.9 Gauges and sizes of metal shall be adequate for various conditions.

.10 Make exposed metal fastenings and accessories of same material, texture, colour and finish as base metal on which they occur unless otherwise shown or specified. Keep exposed fastenings to an absolute minimum evenly spaced and neatly laid out. Make fastenings of permanent type unless otherwise indicated.

2.3 SHOP PAINTING AND PROTECTION

.1 As per SSPC2 Hand Tool Clean and SSPC1 Solvent Clean, clean welds by wire brushing and wash down with clean water, to remove the chemical residues left by the electrodes, prior to painting.

.2 Prepare steel as per SSPC-3 Power Tool Cleaning for Interior or SSPC-6 Commercial Blast Cleaning for exterior members. Remove rust, mill scale, oil, dirt, and other foreign matter before commencing shop painting.

.3 Apply shop coat of primer to all surfaces except areas requiring field welding. Apply by brush, working paint well into surfaces, interstices and cavities.

.4 Primer is to be free of runs, sags, or other collections of primer due to dipping of members into primer.

.5 Steel work shall be painted under cover, and shall remain under cover, until the paint protection is dry.

.6 Prime field welded areas after erection and touch up shop coat where damaged and barred by erection and handling.

.7 Prime steel with two full coats of paint in strict accordance with paint Manufacturer's directions.

.8 Give the parts which are inaccessible after assembly two coats of primer coat paint of different colours, when members are noted to be painted.

2.4 HOT DIP GALVANIZING

.1 Hot dip galvanize, after fabrication, steel metal fabrication items. Straighten shapes and assemblies true to line and plane after galvanizing. Repair damaged galvanized surfaces with brush or spray-applied anti-corrosion coating containing 92-95% zinc, in accordance with manufacturer's printed directions.

.1 Members exposed to elements when in final location.
.2 Members embedded on exterior side of exterior walls.
.3 Members imbedded in concrete.
.4 Members specified in this Section or indicated on Drawings.

.2 Hot-dip galvanize members in accordance with CAN/CSA G164 and requirements of the following ASTM standards, with minimum coating weights or thicknesses as follows:

.1 Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips: ASTM A123/A123M; average weight of zinc coating of actual surface.
.1 4.8mm (3/16") and less member thickness: 600g/m² (2oz./ft²).
.2 6mm (1/4") and heavier members: 640g/m² (2.1oz./ft²).

.2 Iron and Steel Hardware: ASTM A153/A153M; minimum weight of zinc coating, in gram per square meter of surface, in accordance with Table 1 for the various classes of materials used in the Work.

2.5 STAINLESS STEEL FINISHES

.1 Polish Finish: Apply finish after fabrication. Remove tool and die marks and stretch lines or blend into finish. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
.1 Directional Polish: AISI No. 4 bright satin finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish, free of cross scratches. Run grain with long dimension of each piece.

3 Execution

3.1 GENERAL

.1 Verify at site that the Work to receive the work of this Section is free of irregularities detrimental to the installation and performance of the work and that it is located correctly and at proper levels before delivery and installation.

.2 Erection: To meet specified requirements of CAN/CSA-S16.

.3 Bearing Plates and Anchors: Standard.

.4 Anchors: Anchors to structural concrete shall be approved inserts set into concrete or approved self-drilling expansion insets drilled and placed afterwards.

3.2 INSTALLATION

.1 Assemble and erect work plumb, true, square, straight, level and accurate to sizes detailed, to reviewed shop drawings, free from distortion and defects detrimental to appearance and performance.

.2 Isolate contact surfaces to prevent electrolysis due to metal contact with masonry, concrete or dissimilar metal surfaces. Use bituminous paint, building paper, butyl tape or other approved means.

.3 Supply adequate instructions, templates, and if necessary, supervise installation of the fastenings or accessories requiring to be built-in by other Sections of the Work.

3.3 SCHEDULES

.1 Where items are required to be built into masonry, concrete or other work, supply such items to respective Sections with all anchors and accessories for building in.

.2 Itemized List: Supply and install metal work listed below unless specifically designated to be supplied only. Each item shall be as shown on Drawings and as detailed on reviewed shop drawings.

.3 Miscellaneous Steel Framing, Channels, Angles, Plates and Brackets: As required and indicated on Drawings.

.4 Loose Lintels:
- .1 Provide and install loose lintels if not by structural steel.
- .2 Finish: Hot-dip galvanized after fabrication.

.5 Masonry Lateral Supports:
- .1 Install deflection space and lateral support for non-load-bearing masonry walls and partitions in accordance with specified requirements of CAN3-S304-M.
- .2 At walls with concealed tops:
  - .1 75mm x 50mm x 6mm (3" x 2" x 1/4") angles 203mm (8") long on both sides of walls. Anchor to structure above wall.
- .3 At walls with tops exposed to view:
  - .1 75mm x 50mm x 6mm (3" x 2" x 1/4") angles, continuous on both sides of wall. Anchor to structure above wall.
- .4 Finish: Prime paint.

.6 Under-Counter Steel Supports:
- .1 Framing: Continuous channel / angle welded construction.
- .2 Drill 6mm diameter holes at each cross support for fastening of counter.
- .3 Provide concealed steel section posts to support channels at front of counter, for building into wall.
- .4 Provide posts with anchor plates and 9mm diameter bolts for attachment to structure.
- .5 Unless otherwise indicated, provide intermediate posts to support long counter spans.
- .6 Conceal framing from view to greatest extent possible.
- .7 Prime paint finish. Finish paint by Section 09 90 00.

.7 Other Miscellaneous Metal Components:
- .1 General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- .2 Concealed metal angles and support not included in Division 5 Section structural steel, indicated to support exterior cladding and parapets.
- .3 Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- .4 Furnish inserts for units installed after concrete is placed.
- .5 As required and indicated on Drawings.
- .6 Finish: Prime paint for interior components, ready for finishing by Section 09 90 00 and hot-dip galvanized after fabrication for exterior components.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for the design, supply, and installation of steel and iron decorative metal railings complete with all required accessories.

1.3 RELATED REQUIREMENTS

.1 Section 05 50 00
.2 Section 06 10 00
.3 Section 09 90 00

1.4 REFERENCES STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 American Society for Testing and Materials (ASTM International):
- .1 ASTM A29/A29M, Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
- .2 ASTM A36/A36M, Standard Specification for Carbon Structural Steel
- .3 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings
- .4 ASTM A48/A48M, Standard Specification for Gray Iron Castings
- .5 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- .6 ASTM A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- .7 ASTM A513/A513M, Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
- .8 ASTM A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- .9 ASTM B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- .10 ASTM D1187/D1187M, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal
- .11 ASTM E894, Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings
- .12 ASTM E935, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings
- .13 ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- .14 ASTM F594, Standard Specification for Stainless Steel Nuts

.3 American Welding Society, Inc. (AWS):
- .1 AWS D1.6, Structural Welding Code – Stainless Steel

.4 Canadian Standards Association (CSA Group):
.1 CSA A500, Building Guards

.5 Ontario Building Code (OBC)

.6 National Association of Architectural Metal Manufacturers (NAAMM):
.1 NAAMM AMP 521, Pipe Railing Systems Manual.

1.5 DEFINITIONS

.1 Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas and for pedestrian guidance and support, visual separation, or wall protection.

.2 Usage Classifications: NAAMM AMP 510 provides four usage classifications for finishing of metal stair and railing systems as follows, and as listed in Section 05 50 00:
.1 Architectural Class: NAAMM Architectural Class stairs are intended to serve as an architectural feature and can be located in either an open area or in and enclosed stairway in an institutional or commercial building where appearance and finish are of prime importance.

1.6 DESIGN REQUIREMENTS

.1 Structural Performance: Products supplied to Project will be designed, supplied, and installed to meet requirements described in CSA A500 and be capable of supporting occupancy loads on guards and handrails in accordance with Ontario Building Code and account for following:
.1 Principal, Companion, and Service Loads: Deflection limits, and lateral, distributed, and concentrated loads using High Importance Factors.
.1 Railing assemblies to be designed as guard and to withstand a minimum uniform load of 0.75 kN/m or a concentrated load of 1.0 kN at any point applied horizontally to top rail and a minimum of 1.5 kN/m applied vertically to top rail, with individual elements within the assembly designed for a concentrated load of 0.5 kN at any point in the element in accordance with the Building Code.
.2 Movement Loads: Effects of expansion and deflection caused by temperature changes, humidity and building movement.

1.7 ADMINISTRATIVE REQUIREMENTS

.1 Coordinate installation of anchorages for decorative metal railings as follows:
.1 Provide setting drawings, templates, and directions for installing fasteners, including through bolts, washers and nuts, and other accessories.
.2 Schedule installation so railing attachments are made only when the deck and structural components are ready. Do not support decorative metal railings temporarily by any means that do not satisfy structural performance requirements.

1.8 SUBMITTALS

.1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

.2 Product Data: Submit product data for product used in decorative metal railings including, but not limited to, paint products, grout, and fasteners.

.3 Shop Drawings: Submit detailed shop and erection drawings of each decorative metal railing including plans, elevations, sections, and details of decorative metal railings and their connections and as follows:

.1 Show anchorage and accessory items.

.2 Submit shop drawings stamped by a Structural Professional Engineer, licensed in Ontario for load bearing decorative metal railings.

.4 Verification Samples: Submit samples for verification by Consultant for each type of exposed finish required, and as follows:

.1 Sections of each distinctly different linear railing member, including handrails, top rails, caps, posts, and balusters.

.2 Fittings and brackets.

.3 Welded connections.

.3 Informational Submittals: Provide the following submittals when requested by the Consultant:

.1 Welding Certificates: Submit copies of welder certificates signed by Contractor certifying that welders are certified and have the necessary experience to complete work specified in this Section.

.2 Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

.4 Submit qualification data for ornamental fabrication firm demonstrating their capabilities and experience.

1.9 CLOSEOUT SUBMITTALS

.1 Operations and Maintenance Data: Submit copies of manufacturer's written maintenance information for inclusion in operations manual in accordance with Section 01 78 00. Provide specific warning of any maintenance practice or material that may damage or disfigure finished Work.

1.10 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Manufacturer: Obtain materials from single Manufacturer having experience in designing and manufacturing glazed railings and guard systems of similar complexity and extent as that required by work of this Section.

.2 Installer: Use Installers approved by glazed railing systems Manufacturer having experience with similar extent and complexity as that required by work of this Section.

.3 Welders: Perform structural welding using Welders certified by CWB for each type of weld required within past 12 months.

.2 Appearance of Finished Installation: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics:

.1 Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

.2 Performance characteristics are indicated by criteria subject to verification by one or more methods including structural analysis, pre-construction testing, site testing, and in-service performance in accordance with CSA A500.

.3 Do not modify intended aesthetic effects, as judged solely by Consultant, except as specifically directed and accepted by Consultant.

.3 Submit comprehensive explanatory data to Consultant for review where modifications are proposed to meet performance characteristics.

1.11 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver materials to site in good condition and properly protected against damage to finished surfaces.

.2 Storage and Handling Requirements: Store materials on-site in a location and in a manner to avoid damage, and as follows:

.1 Store metal components and materials in a clean, dry location.

.2 Cover with waterproof paper, tarpaulin or polyethylene sheeting in a manner that will permit circulation of air inside the cover.

.3 Keep handling on-site to a minimum.

.4 Exercise care to avoid damage to finishes of material.

1.12 SITE CONDITIONS

.1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where decorative metal railings are indicated to fit within walls and other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.

.2 Established Dimensions: Establish dimensions and proceed with fabricating decorative metal railings without Site measurements where Site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual dimensions correspond to established dimensions; allow for trimming and fitting.

1.13 WARRANTY

.1 Warranty: Provide Manufacturer's standard 2 years warranty against defects in material or workmanship starting from the start date of warranty period in accordance with Section 01 78 36.

2 Products

2.1 MANUFACTURERS

.1 Acceptable Products Manufacturers: Subject to compliance with requirements specified in this Section, use any of the following listed Manufacturers' products in accordance with Section 01 61 00 and Section 01 25 16:
- .1 Dufferin Iron & Railings.
- .2 Hallman Ironworks.
- .3 Omega Iron and Railings.

2.2 MATERIALS

.1 Steel and Iron:
- .1 Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25%.
- .2 Tubing: To ASTM A500/A500M (cold formed) or ASTM A513/A513M.
- .3 Bars: Hot-rolled, carbon steel in accordance with ASTM A29/A29M, Grade 1010.
- .4 Plates, Shapes, and Bars: In accordance with ASTM A36/A36M.
- .5 Cast Iron: Either gray iron, in accordance with ASTM A48/A48M, or malleable iron, to ASTM A47/A47M, unless noted otherwise.

.2 Fasteners:
- .1 Uncoated Steel Components: Plated-steel fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless steel fasteners where exposed.
- .2 Galvanized-Steel Components: Plated-steel fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating.
- .3 Dissimilar Metals: Type 304 stainless-steel fasteners.
- .4 Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- .5 Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless exposed fasteners are unavoidable.
- .6 Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction.
- .7 Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, to ASTM F594.

.3 Miscellaneous Materials:
- .1 Neoprene Rubber Washers: Provide ultraviolet resistant neoprene rubber washers for watertight connection between fasteners and wood structural members.
- .2 Shop Primers: Provide primers that comply with Section 09 90 00.
- .3 Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.3 FABRICATION

.1 Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

.2 Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

.3 Make up wire-rope assemblies in the shop to field-measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum amount is available for tensioning wire ropes. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.

.4 Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32” unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

.5 Form work true to line and level with accurate angles and surfaces.

.6 Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

.7 Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

.8 Connections: Fabricate railings with welded connections unless otherwise indicated.

.9 Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings, and as follows:

- .1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
- .2 Obtain fusion without undercut or overlap.
- .3 Remove flux immediately.
- .4 At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- .5 Weld connections that are not left as exposed joints but cannot be shop welded because of shipping size limitations.
- .6 Do not weld, cut, or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are intended for bolted or screwed site connections.

.10 Form changes in direction as follows:

- .1 As detailed.
- .2 By bending to smallest radius that will not result in distortion of railing member.

.11 Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

.12 Close exposed ends of hollow railing members with prefabricated end fittings.

.13 Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 6mm or less.

.14 Plates, Brackets, Flanges, and Fittings: Provide plates, brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

.15 Provide fasteners for connecting railings to wood structural members, capable of specified design loads and in accordance with the Building Code. Coordinate fastening devices with supporting structure.

2.4 FINISHES

.1 Comply with NAAMM's recommendations for applying and designating finishes.

.2 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

.3 Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

.4 Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

.5 Steel and Iron Finishes:

- .1 Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements of Section 05 50 00 and Section 09 90 00.
- .2 Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - .1 Shop prime uncoated railings with primers specified in Section 09 90 00.
- .3 Paint in accordance with Section 09 00 00.
  - .1 Colour: Black.

2.5 SOURCE QUALITY CONTROL

.1 Engage a Professional Structural Engineer experienced in design and installation of this work and licensed in Ontario:

- .1 Perform timely and regular inspections reviewing fabrication and welding.
- .2 Perform timely and regular inspections reviewing installation of railings.

.3 Verify Work conforms to approved shop drawings and applicable code.
.4 Provide signed and sealed reports of inspections, verifying fabrication, welding, and attachment of railings to structural members are in conformance with design requirements, approved shop drawings, applicable code.

3 Execution

3.1 EXAMINATION

.1 Verify existing conditions before starting work.

.2 Verify that field conditions are acceptable and are ready to receive work.

.3 Examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of work.

.4 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

.1 Install items plumb and level, accurately fitted, free from distortion or defects.

.2 Fit exposed connections together to form tight, hairline joints.

.3 Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
.1 Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
.2 Set posts plumb within a tolerance of 1.5mm in 900mm.
.3 Align rails so variations from level for horizontal members do not exceed 6mm in 3600mm.

.4 Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

.5 Adjust railings before anchoring to ensure matching alignment at abutting joints.

.6 Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

.7 Rail Connections:
.1 Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections as specified in this Section whether welding is performed in the shop or in the field.

.8 Attaching Railings:
.1 Side mount railing posts and base plates to face of main deck stringer beams and built-up rim joists using through bolt connections, complete with neoprene rubber washers.

.9 Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

.10 Field weld components indicated on Shop Drawings. Provide assemblies in one piece or in longest lengths possible.

.11 Concealed Metal Supports: Arrange supports to avoid conflicts with pipes, ducts, framing provided by other sections, and so that they are concealed from view behind finished work.

.12 Perform field welding to CSA requirements.

.13 Obtain approval prior to site cutting or making adjustments not scheduled.

3.3 ERECTION TOLERANCES

.1 Maximum Variation from Plumb: 6mm per storey, non-cumulative.

.2 Maximum Offset from True Alignment: 6mm.

.3 Maximum Out-of-Position: 6mm.

3.4 CLOSEOUT ACTIVITIES

.1 Repairing:

.1 Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

.2 Touch-up Painting: Touch-up painting of field welds, bolted connections, and abraded areas of shop paint as specified in

.3 Section 09 90 00.

.2 Protecting: Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing Manufacturer. Remove protective coverings at time of Substantial Performance.

END OF SECTION

ROUGH CARPENTRY

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

.2 All references standards specified herein imply the latest edition of the standards.

1.2 SUMMARY

.1 Supply all labour, materials, equipment, services and perform all operations required to complete all rough carpentry work to the full intent of the Drawings and as herein specified.

1.3 RELATED REQUIREMENTS

.1 Section 06 15 00
.2 Section 09 21 16
.3 Section 09 90 00

1.4 REFERENCES

.1 ASTM International
- .1 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealled) by the Hot-Dip Process.

.2 CSA International
- .1 CSA B111, Wire Nails, Spikes and Staples.
- .2 CSA O121, Douglas Fir Plywood.
- .3 CSA O141, Softwood Lumber.
- .4 CSA O151, Canadian Softwood Plywood.
- .5 CAN/CSA-O325.0, Construction Sheathing.
- .6 CAN/CSA-Z809, Sustainable Forest Management.

.3 Forest Stewardship Council (FSC)
- .1 FSC-STD-01-001, FSC Principle and Criteria for Forest Stewardship.

.4 Green Seal Environmental Standards (GS)
- .1 GS-11, Paints and Coatings.

.5 National Lumber Grades Authority (NLGA)
- .1 Standard Grading Rules for Canadian Lumber.

.6 Sustainable Forestry Initiative (SFI)
- .1 SFI Standard.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit Manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by Professional Engineer licensed in the Province of Work.

.2 Wood Certification: submit manufacturer's Chain-of-Custody Certificate number for CAN/CSA-Z809 or FSC or SFI certified wood.

1.6 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.

.3 Plywood, OSB and wood based composite panel construction sheathing identification: by grademark in accordance with applicable CSA standards.

.4 Sustainable Standards Certification:

.1 Certified Wood: submit listing of wood products and materials used in accordance with CAN/CSA-Z809 or FSC or SFI.

1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off-the-ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Do not store seasoned materials under conditions that will cause their moisture content to increase. Store preservative treated materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.4 Protect edges and corners of sheet materials from damage during handling and storage. Store and protect wood from nicks, scratches, and blemishes.

.5 Replace defective or damaged materials with new.

2 Products

2.1 MATERIALS

.1 Materials to be best merchantable lumber, straight and sized and shaped to correct dimensions from moisture nominal sizes noted on drawings. Lumber to be selected from well-seasoned stock, free from loose resinous knots, shakes, waxed edges, splits, dry rot or other defects which would impair strength or durability.

.2 Framing Lumber:
.1 Lumber for structural components shall be of species and grade specified, well seasoned, processed and stamped at same mill with appropriate grade markings. Conform to requirements of Standard Grading Rules for Canadian Lumber of National Lumber Grades Authority the (NLGA) with latest supplements, approved by the Canadian Lumber Standards Administrative Board.

.3 Lumber:
.1 Except as indicated or stated otherwise, lumber to be softwood, S4S, moisture content 19% or less, in accordance with the following standards:
.1 CAN/CSA O141 - “Softwood Lumber”.
.2 NLGA - “Standard Grading Rules for Canadian Lumber” (latest supplement).

.4 Framing and Board Lumber:
.1 Treatable Species: No. 2 and better - S4S, Dry, 19%.

.5 Framing, Furring, Strapping, Blocking:
.1 Spruce, 122c, "Standard" light framing, except as otherwise specified.

.6 Plywood Sheathing:
.1 Shall be 19mm (3/4") thick and/or thickness as indicated on Drawings, exterior grade at exterior locations, Douglas Fir plywood, veneer core, Select Sheathing - Tight Face, unsanded, "B" faces and conforming to CSA O121.

.7 Rough Hardware:
.1 Provide rough hardware such as nails, spikes, staples, H-clips, bolts, nuts, washers, screws, clips, strap iron and including hardware for temporary enclosures. Nails for plywood shall be annular or spiral type, all other nails shall be spiral type. All nails, spikes and staples shall conform to CSA B111. All rough hardware shall be galvanized unless otherwise noted. Galvanizing shall conform to CAN/CSA-G164.

.8 All Other Materials and Hardware:
.1 Shall be as noted on Drawings.

2.2 PRESSURE PRESERVATIVE TREATED MATERIALS

.1 Pressure Preservative Treated Lumber: Lumber graded and stamped in accordance with applicable grading rules and standards of associations or agencies approved to grade lumber by Canadian Lumber Standards Accreditation Board in accordance with CAN/CSA O80.
.1 Species: Pine or Spruce-Pine.
.2 Grade: No.2 or better structural posts and lumber, pieces may be grade stamped or shipment certified by letter of compliance.
.3 Grading authority: NLGA, paragraph 131CC
.4 Material having twisted grain or structural defects affecting integrity of lumber will not be acceptable for this project.
.5 Use only material with radius edges, minimum 6mm.
.6 Kiln dry lumber materials to 8% moisture content or less.

.2 Pressure Preservative Treated Plywood: Treated in accordance with CAN/CSA O80 using water-borne preservative to obtain minimum net retention of 4kg/m³ (0.25 lb/ft^3) of wood. Plywood or laminated materials shall be manufactured with exterior grade adhesives. After treatment, plywood shall be kiln dried to moisture content of 8% or less.

.3 Wood Preservative Treatment:
- .1 In accordance with manufacturer's recommendations for surface conditions.
- .2 Wood preservative: odourless chemical water-borne type to CSA O80 Series for natural finish.
- .3 Preservative: suitable for marine environment, ACQ.
- .4 Chromated Copper arsenate (CCA) is not permitted.

.4 Fastener Finishes:
- .1 Galvanizing: to ASTM A123/A123M or ASTM A653, use galvanized fasteners for exterior work.

.5 Primers, Paints and Coatings: in accordance with Manufacturer's recommendations for surface conditions.

2.3 PRESSURE FIRE RETARDANT TREATED MATERIALS

.1 Treat by pressure impregnation with fire-retardant chemicals in accordance with CAN/CSA O80 to provide classification for flame spread of not more than 25, smoke developed of not more than 75 in accordance with CAN4 S102.

.2 All fire-retardant wood must comply with the requirements in AWPA Standard C20 for lumber and C27 for plywood.
- .1 AWPA C20: Structural Lumber, Fire-Retardant Pressure Treatment, lumber materials shall only be of species listed. After treatment, lumber 50mm (2”) or less in thickness shall be kiln dried to moisture content of 8% or less.
- .2 AWPA C27: Plywood, Fire-Retardant Pressure Treatment, plywood or laminated materials shall be manufactured with exterior grade adhesives. After treatment, plywood shall be kiln dried to moisture content of 8% or less.
- .3 All species to comply with CAN4 S102 for surface-burning characteristics and shall bear identification showing classification and type of fire retardant.

.3 Each piece or bundle of fire-retardant treated material or panel to bear ULC inspection label or stamp attesting to FRS rating indicating flame spread, smoke developed, and fuel contributed classification meeting AWPA standard C20 and C27 for Type A Use.

.4 Fire retardant chemicals used to treat lumber must comply with FR-1 of AWPA Standard P17 and shall be free of halogens, sulphates and ammonium phosphate.

.5 Acceptable materials: Plywood and lumber materials treated by licensed applicators with fire retardant materials from the following:
- .1 Dricon FRTW by Hickson Corporation.
- .2 Pyro-Guard by Hoover Treated Wood Products Inc.

.3 D-Blaze by Chemical Specialties Inc.

2.4 ACCESSORIES

.1 Fasteners: to CAN/CSA-G164, for exterior work, marine environment.

.2 Nails, spikes and staples: to CSA B111.

.3 Bolts: 12.5mm diameter unless indicated otherwise, complete with nuts and washers.

.4 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, recommended for purpose by manufacturer.

3 Execution

3.1 INSTALLATION-GENERAL

.1 Consult with and co-operate with other Sections in advance and build-in or make provisions for installation of other work.

.2 Provide and fit in place all furring, strapping, battens, nailers, sleepers, grounds and blocking required to provide adequate properly placed fixing for all wood finishes, fitments and as required for the work of other trades.

.3 Blocking, strapping and other rough carpentry indicated shall not be regarded as complete or exact. Provide all rough carpentry work required, whether specifically shown or not. Grounds shall be of a thickness to provide for application of finishes. Room side surfaces of grounds shall be plumb and in true plane throughout.

.4 All nails shall be long enough so that at least half their length penetrate in to the second member. Splitting of wood members shall be minimized by staggering the nails in the direction of the grain and by keeping nails well in from edges.

.5 Blocking shall be through-bolted to structure.

.6 Anchor rough bucks to concrete or masonry with 9.5mm (3/8") diameter expansion bolts and shields or Drummond and Reeves security buck anchors, minimum three per jamb.

.7 Construct continuous members from pieces of longest practical length.

.8 Select exposed framing for appearance. Install lumber materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.

.9 Countersink screws and bolts where necessary to provide clearance for other work.

3.2 WOOD BLOCKING, CANTS AND NAILERS

.1 Provide wood blocking, cants and nailers, where shown to be required as detailed. Bolt securely in place. Block under cants same thickness as installed roof insulation.

.2 Check mechanical, electrical, architectural Drawings and provide all blocking, cants, nailers etc. required. Leave work ready for built-up bituminous roofing and prefinished sheet metal flashings.

3.3 PLYWOOD PANELS

.1 Provide plywood panels required for electrical/telephone mounting of equipment and in other locations as indicated on Drawings.

3.4 PRESSURE PRESERVATIVE TREATED WOOD INSTALLATION

.1 Comply with AWPA M4.

.2 Treat surfaces of material with wood preservative, before installation.

.3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation. Allow first coating to fully soak into grain before applying second coating in accordance with Manufacturer's instructions.

.4 Remove with fine sandpaper, chemical deposits on treated wood to receive applied finish.

.5 Use only hot-dipped galvanized, corrosion resistant nail or screw fasteners. Staples are not acceptable for installation of preservative treated materials.

.6 Use water-borne preservative treated wood for:
- .1 Wood in contact with masonry or concrete,
- .2 Wood within 450mm (18") of grade,
- .3 Wood decking and fence boards,
- .4 Wood in contact with flashings,
- .5 Wood in contact with waterproofing membranes, confirm compatibility with membrane manufacturer prior to application.

3.5 PRESSURE FIRE RETARDANT TREATED WOOD INSTALLATION

.1 Field Cuts:
- .1 Do not rip, mill or conduct extensive surfacing of fire-retardant treated lumber, label will be voided.
- .2 Only end cuts, drilling holes and joining cuts are permitted.
- .3 All cuts on plywood will be considered end cuts.
- .4 Fire-retardant lumber and plywood can be given a light sanding for cosmetic cleaning after treatment.
- .5 Pre-cut to the greatest extent possible before treating.

.2 Fire retardant treated plywood used in structural applications shall be graded or span-rated material.

.3 Use only hot-dipped galvanized, corrosion resistant nail or screw fasteners. Staples are not acceptable for installation of fire-resistant treated materials.

.4 Where humidity conditions are such that moisture may condense between hardware and treated wood, hardware shall be back-primed with a corrosive-inhibitive paint.

.5 Back-prime at contact points and fasteners to prevent electrolysis when fire retardant framing members are used in metal buildings.

END OF SECTION

WOOD DECKING

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

.2 All references standards specified herein imply the latest edition of the standards.

1.2 RELATED REQUIREMENTS

.1 Section 06 10 00

1.3 REFERENCES

.1 ASTM International
- .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM F1667/F1667M, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples

.2 CSA International
- .1 CSA B111, Wire Nails, Spikes and Staples.
- .2 CAN/CSA O80 Series, Wood Preservation.
- .3 CSA O86 Consolidation, Engineering Design in Wood.
- .4 CAN/CSA-Z809, Sustainable Forest Management.

.3 Forest Stewardship Council (FSC)
- .1 FSC-STD-01-001, FSC Principle and Criteria for Forest Stewardship.

.4 Green Seal Environmental Standards (GS)
- .1 GS-36, Commercial Adhesives.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

.6 National Lumber Grades Authority (NLGA)
- .1 Standard Grading Rules for Canadian Lumber.

.7 Sustainable Forestry Initiative (SFI)
- .1 SFI Standard.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for wood decking and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies of WHMIS SDS - Safety Data Sheets in accordance with Section 01 61 00.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by Professional Engineer licensed in the Province of Work.

.4 Samples:
.1 Submit for review and acceptance of each unit.
.2 Samples will be returned for inclusion into work.
.3 Submit two 300 x 300mm samples of each type.

.5 Certifications: Submit certificates signed by Manufacturer certifying materials comply with specified performance characteristics and physical properties.

1.5 QUALITY ASSURANCE

.1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Sustainable Standards Certification:
.1 Certified Wood: Submit listing of wood products and materials used in accordance with CAN/CSA-Z809 or FSC or SFI.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Manufacturer's instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with Manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with Manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect wood decking from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse pallets, packaging materials, crates, and padding, in accordance with Section 01 74 00.

2 Products

2.1 MATERIALS

.1 Wood decking: to NLGA standard Grading Rules for Canadian Lumber, Select grade Eastern Whit Cedar, 50mm x 150mm. Kiln dry decking to 15% maximum moisture content.
.1 CAN/CSA-Z809 or FSC or SFI certified.

.2 Decking lengths: 1.8 to 6m or longer with a minimum of 90% planks exceeding 3m. For single spans shorter than 3m use decking of same length as span.

.3 Nails: to ASTM F1667, hot dipped galvanized finish; sizes to CSA O86. Supply 200mm spiral spikes for lateral nailing.

.4 Wood preservative: odourless chemical water-borne type to CSA O80 Series for natural finish; Use Category UC4.2.

.5 Preservative: suitable for marine environment, ACQ.

3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for wood decking installation in accordance with Manufacturer's written instructions.
- .1 Visually inspect substrate.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

.1 Do wood deck work in accordance with CSA O86, except where specified otherwise.

.2 Install decking in accordance with CSA O86, controlled random pattern with two nails per support.

.3 Provide minimum of one bearing support for each plank.

.4 Install sloping deck with tongues up. Join butt ends with splines to assure tight square fit.

.5 Stagger end joints in adjacent planks minimum of 0.5m.
- .1 Separate joints in same area by at least 2 intervening courses.
- .2 Avoid joints in first fifth of end spans.
- .3 Minimize joints in middle third of span.

.6 Apply preservative to end cuts of pressure treated lumber.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00.
- .1 Leave Work area clean at end of each day.

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

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by wood decking installation.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

.2 All references standards specified herein imply the latest edition of the standards.

1.2 SECTION INCLUDES

.1 Custom Plastic Laminated (PLAM) Casework.

.2 Countertops.

.3 Cabinet hardware.

.4 Shelving.

1.3 PERFORMANCE REQUIREMENTS

.1 Design cabinets capable of withstanding the effects of earthquake motions determined according to applicable code. Provide anchorage on cabinets exceeding 1200mm in height or, where they are likely to be hazard from overturning.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:
- .1 Coordinate with other work having a direct bearing on work of this Section.
- .2 Coordinate the work with mechanical, electrical and electrical rough-in, installation of associated and adjacent components.
- .3 Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.
  - .1 Coordinate metal reinforcement by Section 09 21 16 with mounting requirements and wall cleats for wood paneling, base and upper cabinets and accessories.

.2 Pre-installation Meeting:
- .1 Convene 1 week before starting work of this Section; conduct meeting at Project site.
- .2 Require attendance of the Consultant, Installer, Manufacturer and other parties directly affected by the work of this Section.
- .3 Review preparation and installation procedures, coordination and scheduling required with related work, referenced installation standards, Manufacturer's installation instructions and warranty requirements.
- .4 Prepare and distribute minutes of meeting to Owner and participating parties.

1.5 SUBMITTALS FOR REVIEW

.1 Product Data:
- .1 Provide data for panel products, cabinet hardware and accessories, and finishing materials and processes.

.2 Shop Drawings:
- .1 Indicate materials, component profiles, plans, sections and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.
- .2 Show locations and sizes of cut-outs and holes for plumbing items, electrical wiring, switches, and outlets, and other items installed in cabinets.

.3 Samples:
- .1 Provide two 300 x 300mm samples illustrating each cabinet and shelving unit finish.
- .2 Provide two samples of drawer pulls and hinges illustrating hardware finish.

1.6 SUBMITTALS FOR INFORMATION

.1 Qualifications Data: For Fabricator and Installer.

.2 Installation Data: Provide application instructions.

.3 Inspection reports.

1.7 QUALITY ASSURANCE

.1 Perform work in accordance with Architectural Woodwork Institute (AWI), Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Woodwork Institute's (WI) North American Architectural Woodwork Standards (NAAWS), Premium Grade.

.2 Fabricator Qualifications: Company specializing in fabricating Products specified in this Section with minimum 5 years' documented experience.

.3 Installer Qualifications: Company specializing in fabricating Products specified in this Section with minimum 5 years' documented experience.

1.8 MOCK-UP

.1 Provide mock-up of:
- .1 Full size, one of each type of millwork unit.
- .2 Full size, base cabinet and upper cabinet including plumbing accessories and fitments.

.2 Locate where directed by Consultant.

.3 Approved mock-up may remain as part of the Work.

1.9 DELIVERY, STORAGE, AND PROTECTION

.1 Protect units from moisture damage.

1.10 ENVIRONMENTAL REQUIREMENTS

.1 During and after installation of work of this Section, maintain the same temperature and humidity conditions in building spaces as will occur after occupancy.

2 Products

2.1 LUMBER MATERIALS

.1 Hardwood Lumber: NAAWS Premium Grade; maximum moisture content of 6%; of quality suitable for transparent finish, certified to FSC STD-04-004.

2.2 SHEET MATERIALS

.1 Sheet Products:
- .1 Graded in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 4 requirements for quality grade specified;
  - .1 Veneer Face Grade: AA.

.2 Sheet Cores:
- .1 Medium Density Fibreboard (MDF):
  - .1 Composed of wood fibres, medium density, FSC certified; of grade to suit application; sanded faces, formaldehyde free binder with 100% recycled and recovered fibre conforming to ANSI A208.2. Moisture resistant MDF panel to be used in all high moisture locations.
  - .2 Acceptable Product:
    - .1 Dry locations:
      - .1 Roseburg Forest Products ‘Medite II’
      - .2 Uniboard 'MDF Excel'
      - .3 Arauco 'Trupan'
    - .2 Wet locations:
      - .1 Roseburg Forest Products ‘Medex’
      - .2 Arauco 'Trupan Moisture Resistant'
      - .3 Uniboard 'NU Green MR-50'
- .2 Veneer Core Plywood:
  - .1 Non-Telegraphing, to AWCSA O153, Type II adhesive, Poplar plywood, exterior, waterproof, sound grade, good two sides, sanded faces without voids or defects, no added urea formaldehyde, 19mm thick unless otherwise indicated or specified.

.3 Hardwood veneer core plywood:
- .1 Veneer core plywood cores for countertops: CSA O153, Poplar plywood, exterior, waterproof, sound grade, good two sides, sanded faces without voids or defects, no added urea formaldehyde, 19mm thick unless otherwise indicated or specified.
- .2 Baltic Birch Plywood for drawers and drawer bodies: NAAWS premium grade, FSC Certified, Baltic Birch plywood with single piece face veneer, good two sides, sanded faces without voids or defects, no added urea formaldehyde, 12mm and 15mm thick.

2.3 LAMINATE MATERIALS

.1 Plastic Laminate (PLAM): NEMA LD3, continuous (through) colour high pressure decorative laminate (HPDL), Grade VGS; selected from Manufacturer's full colour range, with matte and high gloss finishes.
  .1 Refer to Schedule of Finishes for type, product and colour.

.2 Cabinet Liner: NEMA LD3, Grade CLS, not less than 0.5mm thick.
  .1 Colour: As selected by Consultant.

2.4 CASEWORK

.1 Plastic Laminate Casework:
  .1 Grade: NAAWS Premium Grade.
  .2 Sheet Core: Minimum 19mm thick MDF to meet NAAWS grade specified.
  .3 Construction Type: NAAWS construction type to be Frameless.
  .4 Cabinet and door interface: flush overlay.
  .5 Exposed Surfaces: HPDL, colour, finish and pattern direction, meeting requirements of NAAWS for Grade specified.
  .6 Exposed interior surfaces: HPDL matching exposed surfaces.
  .7 Semi-exposed surfaces: Cabinet liner matching exposed surfaces.
  .8 Edgeband: HPDL
    .1 Edgeband at doors, drawer fronts, and false fronts: 3mm thick. Colour and texture to match casework face.

.2 Drawers: NAAWS Premium Grade:
  .1 Side Construction: Baltic Birch Veneer core plywood core, 12mm thick core, dovetailed or lock-shoulder jointed into 15mm body and back.
  .2 Bottom Construction: Baltic Birch Veneer core plywood, 6mm material, dadoed into body (subfront and back) and sides.
  .3 Drawer Face: Matching cabinet exposed surface finish and core material.
  .4 Finish:
    .1 Side back and sub-face: to match casework semi-exposed finish.
    .2 Drawer face: to match casework exposed surface finish.

.3 Wall Cabinets: NAAWS Premium Grade, with finish to match base cabinets.
  .1 Provide top and bottom Fillers and Corner Panels.
  .2 Provide scribes and fillers with a max. 25mm exposed dim.
  .3 Underside of Cabinets: Type 'B' flush (one tight joint line visible).
  .4 Provide custom valances at underside of cabinets as shown.
  .5 Wall Cabinet Bulkheads: Provide custom wood paneling as shown.
  .6 Cabinet Backs (Wall Hung Cabinets): Wall hung cabinet backs must not be relied upon to support the full weight of the cabinet and its anticipated load for hanging/mounting purposes. Method of back joinery and hanging/mounting mechanisms should transfer the load to case body members.

.4 Shelving: NAAWS Premium Grade.
  .1 Construction: To match Exposed panel products.
  .2 Core: to meet NAAWS grade and loading requirements.
  .3 Panel Edge Band: To match exposed panel product finishes.

.4 Provide adjustable shelves in all cabinets, set shelf standards flush with surface of gables unless shown or called for otherwise. Set shelf brackets within cabinets flush with underside of shelf.

.5 Provide custom dropped heavy duty front edges as shown.

2.5 SOLID SURFACING FABRICATIONS, COUNTERTOPS AND TRIM

.1 Division 6 Section Solid Surfacing Fabrications; Fabrications, countertops and trim installed by Section 06 61 16.

2.6 STAINLESS STEEL COUNTERTOPS

.1 Construction: Stainless steel backed by wood core.

.1 Core material: 19mm (3/4”) plywood on lumber support ledges.

.2 Stainless Steel Cladding: Refer to Section 12 36 17.

2.7 PLASTIC LAMINATE COUNTERTOPS

.1 NAAWS Premium Grade.

.2 Plastic Laminate material and colour: Refer to Schedule of Finishes.

.3 Core material: Veneer core plywood for Wet Areas.

.4 Back splashes: butt joint per drawings, 102mm high unless otherwise noted.

.5 Front edges: as per Drawings.

2.8 ACCESSORIES AND AUXILIARY MATERIALS

.1 Adhesive: Type recommended by NAAWS to suit application.

.2 Fasteners: Size and type to suit application.

.3 Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; nickel plated finish in concealed locations and stainless-steel finish in exposed locations.

.4 Concealed Joint Fasteners: Threaded steel.

.5 Tape: Aluminum foil, insulating and heat dissipating tape. Use butyl tape for isolating wood from masonry or cementitious materials.

.6 Stainless Steel Sheet: ASTM A 666, Type 304 with AISI No. 4 brushed finish; thicknesses as indicated.

.7 Steel Sections for Counter Supports: As specified in Section 05 50 00.

2.9 HARDWARE

.1 General: Manufacturer’s products specified or indicated represent standard of quality required. Provide specified or indicated products or approved alternative products having the same functional and appearance characteristics and conforming to or exceeding the requirements of CAN/CGSB-69.25/ANSI/BHMA A156.9.

.2 Metal Hardware Finish: Nickel plate, unless otherwise specified.

.3 Hardware for 19mm Thick Doors:
- .1 Hinges: 170° swing, soft close, unless indicated otherwise, fully concealed, all metal; Product: Blum 90 series or Euromat Series by Hettich International.
- .2 Magnetic Latch: Magnetic, automatic opening, touch latch; Product: BP509690 by Richelieu or approved equivalent.

.4 Hinges: Soft Close, full metal, nickel plated, concealed, spring loaded, soft close, 110° and 170° hinges.

.5 Cabinet Door Pivot Hinge:
- .1 Hinges: 270° swing, unless indicated otherwise, all metal; Product: 344.06.900 Aximat 300 TM Institutional Hinge by Häfele Co.

.6 Piano Hinges: Full metal, 1.5mm type 304 stainless steel, 50mm wide continuous hinge.

.7 Hasp Lock: Hasp Cam Lock, formed for attachment with mechanical fasteners; Matt Nickel finish.
- .1 Product: Item No. 235.17.600 Hasp Cam Lock by Hafele, C8173 or C8178 by Compx National or approved equivalent.

.8 Drawer Slides: Electro-plated zinc screw mounted, heavy duty, full extension type with captive profile to eliminate side movement, soft close, positive in and out stops and, load capacity to suit drawer size with minimum static load rating of 27kg for drawers 150mm and less, and 40kg for drawers over 150mm in depth, lengths to suit application, side-mounted type.
- .1 Product: Metabox 320 Series by Blum, Accuride Series 3832EC by Richelieu, or approved equivalent.

.9 File Drawer Slides: Metafile System ‘ZRM55030’ by Richelieu or ‘TandemBox Filing Drawer, 500mm deep’ by Blum or approved equivalent.

.10 Drawer and Door Bumpers: Permanently fixed polyurethane type, clear colour.

.11 Pulls:
- .1 Pull Type 1: D-shaped pulls, satin stainless steel, 100mm long unless noted otherwise on Drawings.
- .2 Casework Horizontal Drawer and Door Pulls: Stainless steel pull, U-shaped, satin finish; Centered and full width of drawers and doors minus 75mm each side of door or drawer panel.
- .3 Swing Door Pulls: U shape, satin stainless steel finish 400mm high.

.12 Elbow Catches: Two-piece design, to inactive cabinet / cupboard door leaf of paired locking doors.
- .1 Product: 5540180 by Richelieu or approved product.

.13 Drawer and Hinged Door Locks: Cylindrical (cam) type, 6-pin tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1.
- .1 Size to suit door or drawer thickness. Coordinate final keying requirements with Owner. Assume all locks keyed alike in each room.
- .2 Provide a minimum of three keys per lock.
- .3 Product: Sargent 4142, or approved equivalent.

.14 Shelf Supports:
.1 Pin shelf support: Nickel-plated steel pin shelf support, 5mm diameter; Product: No. 282.38.708 by Hafele or approved equivalent.

2.10 FABRICATION

.1 Fabricate to NAAWS Grade standards indicated in Part 2.

.2 Shop prepare and identify components for matching during site assembly.

.3 Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.

.4 When necessary to cut and fit on-site, provide materials with ample allowance for site cutting and scribing.

.5 Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.

.6 Acrylic sheet:
.1 Fabricate and join acrylic materials in accordance with Manufacturer's written instructions.

.7 Provide cut-outs for plumbing fixtures and fittings. Verify locations of cut-outs from site dimensions. Seal cut edges.

.8 Stainless Steel: Fabricate to required shapes and sizes, true to line and level. Mill joints to a tight, hairline fit. Cope or miter corner joints. Remove burrs and ease edges Remove sharp or rough areas on exposed surfaces:
.1 Base (Kick): Fabricate from 1.6mm thickness stainless steel sheet with horizontal directional finish; heights as indicated on Drawings.
.2 Trim Plates: Fabricate from stainless steel sheet, thickness as shown with horizontal directional finish.

2.11 SHOP FINISHING

.1 Factory finish all millwork to NAAWS Premium standards. No field finishing permitted except for minor retouching.
.1 Finishing of Concealed Areas and Back Priming: Apply two coats of sealer to concealed cabinets interiors and backs.

.2 Wood Finishes:
.1 Clear finish for wood veneer: NAAWS water-based conversion varnish finish system; formaldehyde free and low VOC; Sheen: 12% sheen.
.1 Acceptable Product:
.1 Zenith by Valspar.
.2 Chemcraft 'Airguard Waterborne Clear TC'

.3 Stainless Steel Finishes: AISI No. 4 brushed finish.

3 Execution

3.1 EXAMINATION

.1 Verify existing conditions before starting work.

.2 Verify adequacy of backing and support framing.

.3 Verify location and sizes of utility rough-in associated with work of this Section.

3.2 INSTALLATION

.1 Install Work in accordance with NAAWS Premium Grade.

.2 Set and secure casework in place; rigid, plumb, and level. Provide anchoring to conform to seismic requirements.

.3 Use fixture attachments in concealed locations for wall mounted components.

.4 Use concealed joint fasteners to align and secure adjoining cabinet units and counter tops.

.5 Carefully scribe casework abutting other components, with maximum gaps of 1mm. Do not use additional overlay trim for this purpose.

.6 Secure cabinet counter bases to floor using appropriate angles and anchorages.

.7 Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

.8 Isolate wood members in contact with masonry or cementitious construction with butyl tape.

.9 At junctions of counter and back splash and at junctions of cabinets and adjacent wall finishes, apply small bead of clear silicone sealant.

3.3 ADJUSTING

.1 Test installed work for rigidity and ability to support loads.

.2 Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

.1 Clean installed work.

.2 Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SECTION INCLUDES

.1 Polymer based solid surface (PSS).

1.3 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 ANSI ICPA SS1, Performance Standard for Solid Surface Materials.

.3 CAN/ULC S102, Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS FOR REVIEW

.1 Shop Drawings: Indicate all dimensions, component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work.

.2 Samples: Submit two 50 x 50mm samples of each colour and finish.

1.5 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: Submit manufacturer's instructions for care and maintenance of solid surface materials including repair instructions.

1.6 QUALITY ASSURANCE

.1 Fabricator/Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years' experience and certified by the Manufacturer.

1.7 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.

1.8 WARRANTY

.1 Provide 10 year manufacturer warranty against defects in materials and workmanship under normal usage. Warranty shall provide for all material and labour to repair or replace defective materials.

2 Products

2.1 MANUFACTURERS

.1 Subject to conformance with the requirements of this Section provide product by Manufacturer named as the basis-of-design or approved equivalent product by an acceptable Manufacturer.

.2 Basis of Design: Refer to Section 09 06 00.

2.2 MATERIAL

.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 Countertops: 12mm thick countertop; edge details as indicated on the Drawings. Provide counters complete with backsplash of size shown on the Drawings.

.1 Colours: Refer to Schedule of Finishes.

.2 Configuration: Provide countertops with front and backsplash style as indicated.

.3 Backsplashes and Endsplashes: Where indicated, same material as countertop, thickness as recommended by Manufacturer.

.4 Fabrication: Fabricate tops and backsplashes with square edges, in one piece to greatest extent possible, unless otherwise indicated.

2.3 ACCESSORIES

.1 Joint adhesive: Manufacturer's recommended adhesive designed to create chemically bonded, inconspicuous, non-porous joints.

.2 Panel Adhesive: Manufacturer’s standard neoprene-based panel adhesive meeting ANSI A136.1-1967, UL listed.

.3 Sealant: Mildew-resistant, FDA/UL recognized silicone sealant in colour matching or clear formulations as specified.

2.4 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 cut-outs for plumbing and bath accessories as indicated on the Drawings.

.5 Rout and finish component edges to a smooth, uniform finish. Rout all cut-outs, then sand all edges smooth. Repair or reject defective or inaccurate work.

.6 Finish: All surfaces shall have uniform finish.

.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.

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 Provide backsplashes where indicated on the Drawings. Adhere to countertops using Manufacturer's standard colour-matched silicone sealant.

.4 Keep components and hands clean during installation. Remove adhesives, sealants and other stains. Components shall be clean on Date of Substantial Completion.

.5 Make plumbing connections to sinks in accordance with Mechanical.

.6 Rigidly anchor to substrate to prevent misalignment.

3.2 TOLERANCES

.1 Variation in component size: ± 3mm.

.2 Location of openings: ± 3mm from indicated location.

3.3 PROTECTION

.1 Protect completed installation from damage with heavy kraft paper cardboard until date of final inspection.

3.4 ADJUSTING AND CLEANING

.1 Repair damaged and defective countertops to eliminate functional and visual defects; where not possible to repair, replace. Adjust joinery for uniform appearance.

.2 Remove all excess adhesives, sealants and other contaminates from installation and all adjacent surfaces. Clean countertops on exposed and semi-exposed surfaces.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

.2 All references standards specified herein imply the latest edition of the standard on the date for receiving bids.

1.2 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

.2 Maintain the existing building watertight at all times. Provide required temporary protection, and enclosures. Seal off or temporarily dam open roof edges to prevent any incidence of water into existing building or structure.

1.3 QUALITY ASSURANCE

.1 Tie-in new work with adjacent existing roofing system in accordance with the Manufacturer's recommendations for the products used. All products to be compatible with the existing and new roofing system components.

.2 Do work to maintain existing roof warranty.

.3 All work shall meet the requirements and all amendments of the Canadian Roofing Contractors Association (CRCA.), and local provincial Roofing Contractors Association of the project.

.4 Applicators: Member in good standing of the Canadian Roofing Contractors Association and which has a minimum of 5 years of proven satisfactory experience in the Work of this Section.

.5 Ensure surfaces to receive work of this Section are clean, level, smooth, solid and dry before commencing work each day.

.6 Ensure temperatures during application are not less than the minimum recommended by the material Manufacturer. Do not perform work during inclement weather conditions.

.7 Stop work when temperature remains consistently below recommended temperature.

.8 Use only dry materials and apply only during weather that will not introduce moisture into roofing system.

.9 Arrange for roofing material Manufacturer's representative to visit the site and discuss roofing application and any special requirements, prior to commencement of work.

1.4 SUBMITTALS

.1 Provide submittals specified and as required to assess conformance with the Contract Documents and Section 01 33 00.

.2 Shop Drawings: Provide shop drawings showing complete details of all conditions, construction and interfacing with work of other Sections.

.3 Product Data: Submit 3 copies of the Manufacturers' recommended roofing inspection and maintenance procedures for inclusion in the maintenance instructions and data book.

1.5 PROTECTION

.1 Provide all necessary protection measures to prevent fumes, dust particles, odours and other foreign matter created or caused by roofing operation from entering the building, including the return air ducts.

.2 Provide temporary protection at work areas or access to work areas with minimum 13mm (½") plywood underlaid with 25mm (1") polystyrene insulation board extending 1m (3') beyond work area. Remove protection at completion of work.

.3 Prevent bitumen, precipitation and debris entering openings and drains during work.

.4 Cover walls and adjacent work where materials hoisted or used. Locate kettles so that smoke and fumes will not discolour the building or adjacent buildings or become a nuisance to adjacent owners or the public.

.5 Use warning signs and barriers. Maintain in good order until completion of work.

.6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed work and materials out of storage.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in original containers, sealed, with labels intact.

.2 Do not store insulation in direct contact with the earth, road surface, or roof deck. Place suitable supports under the insulation upon delivery to protect it from absorbing dampness from the surrounding terrain or deck.

.3 Store materials to manufacturer's instructions. Provide and maintain dry, off-ground weatherproof storage. Take particular care to prevent materials from absorbing moisture. Remove unsatisfactory materials promptly and provide new dry materials.

.4 Deliver fasteners in boxes or kegs and keep in protective storage until used. Do not oil or grease fasteners.

.5 Remove materials only in quantities required for same day use.

.6 Remove and replace damaged, wet or broken materials.

.7 Cover gravel during inclement weather.

.8 Store materials away from open flame or ignition sources.

1.7 WARRANTY

.1 Provide Canadian Roofing Contractors Association (CRCA) and local provincial Roofing Contractors Association's Standard Form of Warranty, complete with a

copy of the CRCAs Preventative Maintenance Manual or similar written warranty acceptable to the Owner and the Consultant. The warranty shall be for a period of two years from start date in accordance with Section 01 78 36.

.2 Provide material and material/labour warranties offered by the material Manufacturers.

.3 Repair defects within 24 hours of notification.

.4 Inspect the roof 30 days before expiry of warranty and correct defects within 15 days of inspection. This inspection shall be performed at no additional cost to the Owner.

.5 Carry out repair work required under the warranty in accordance with the recommendation of the Consultant.

2 Products

2.1 MATERIALS

.1 Roofing products: Matching and compatible with existing installed materials.

3 Execution

3.1 EXAMINATION

.1 Examine site conditions and surfaces to ensure that they are in satisfactory condition for the commencement of the work of this section. Do not proceed with work until surfaces are satisfactory.

.2 Examine existing work to ensure materials used for work of this Section are compatible with and matching existing roofing system.

3.2 ROOFING

.1 Remove only areas of the existing roofing system which can be replaced, complete with membrane flashings, on the same day.

.2 Adequately install cants at junctions between horizontal and vertical surfaces. Provide tight flush joints between length of cants and mitre corners.

.3 Provide roofing and flashing construction to matching existing.

.4 Install sheet metal work in accordance with CRCA specifications, using concealed fastenings except where approved before installation.

.5 Fabricate metal flashings and other sheet metal work to details shown. Form pieces in 8’ maximum lengths. Make allowance for expansion at joints.

.1 Hem exposed edges on underside 13mm (1/2”). Miter and seal corners with sealant.

.2 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.3 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

.4 Counterflash membrane flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips.

.5 Lock end joints and caulk with sealant.

3.3 CLEANING

.1 Remove all existing debris from all roof areas.

.2 Clear out roof drains, scuppers, eaves troughs and down spouts of debris resulting from work of this Section and ensure they are free draining at project completion.

.3 Daily as the work proceeds and on completion, remove all surplus materials and debris resulting from work.

.4 Remove stains, caulking or other adhesive from all affected surfaces.

END OF SECTION

1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of self-adhered air and vapour membranes that prevent exfiltration and infiltration between interior and exterior of building through wall transition construction.

1.2 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 American Society for Testing of Materials (ASTM):
- .1 ASTM E96/E96M, Standard Test Methods for Water Vapour Transmission of Materials.
- .2 ASTM E2178, Standard Test Method for Air Permeance of Building Materials.

1.3 DEFINITIONS

.1 Air Vapour Barrier Material: A primary element that provides a continuous barrier to the movement of air.

.2 Air Vapour Barrier Accessory: A transitional component of the Air Vapour Barrier that provides continuity.

.3 Air Vapour Barrier Assembly: The collection of Air Vapour Barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Installation Conference:
- .1 Convene a pre-installation conference 2 weeks prior to commencing work of this Section. Require attendance of parties directly affecting work of this Section, including, but not limited to, the Owner's representative, Consultant, General Contractor, air and vapour barrier membrane Contractor, air and vapour barrier membrane Manufacturer's representative and substrate Installer.
- .2 Contact Consultant 2 weeks prior to pre-installation conference to confirm schedule.
- .3 Review preparation and installation procedures and co-ordinating and scheduling required with related work.
- .4 Record discussions of conference and decisions and agreements (or disagreements) reached and furnish copy of record to each party attending. Review foreseeable methods and procedures related to the vapour permeable air barrier membrane, including the following:
  - .1 Tour, inspect and discuss condition of substrate, penetrations and preparatory work performed by other trades.
  - .2 Review surface preparation, minimum curing period and installation procedures.
  - .3 Review special details and flashings.

.4 Review required submittals, both completed and yet to be completed.
.5 Review and finalize construction schedule related to work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
.6 Review required inspections, testing, protection and repair procedures.
.7 Review weather and forecasted weather conditions, and procedures for coping with unfavourable conditions.

.2 Coordination: Coordinate interface of membranes specified in this Section with adjacent systems to ensure continuity of system and that junctions between various components are effectively sealed; verify with Manufacturers and Installers for installation procedures of materials incorporated into air and vapour membrane elements including membranes, transitions, coatings and sealants and continuity with roofing membrane.

1.5 SUBMITTALS

.1 Provide submittals in accordance with the General Conditions and Section 01 33 00.

.2 Action Submittals:
.1 Product Data: Submit Manufacturer's product literature, and installation instructions required for complete and proper installation of air and vapour retarder elements including membranes, primers, fasteners, proprietary application equipment, etc.
.2 Samples: Submit representative sample of air and vapour membrane minimum 305mm x 305mm (12" x 12") with factory applied identification clearly visible.

.3 Safety Data Sheets:
.1 Submit WHMIS safety data sheets for inclusion with project record documents. Keep one copy of WHMIS safety data sheets on-site for reference by workers.

1.6 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:
.1 Manufacturer: Obtain air and vapour membrane materials through one source from a single Manufacturer or using materials from a secondary source that are acceptable to the Manufacturer.
.2 Installer: Use an installation company that is acceptable to the Manufacturer, using workers who are trained and approved by the membrane Manufacturer having experience with projects of similar complexity and area.

1.7 ENVIRONMENTAL CONDITIONS

.1 Air and vapour barrier is not to be applied to surfaces that are either wet, oily, frosted, dirty or contaminated in any way.

.2 Ambient Conditions: Apply air and vapour membrane to substrate surfaces that are within Manufacturer's installation temperature threshold range accounting for wind cooling and apparent temperature when actual temperature is approaching Manufacturer's minimum temperature threshold.

.3 Air and vapour barrier is not to be applied over lightweight cast-in-place concrete containing high moisture or certain curing compounds. Cast-in-place concrete should be cured for a minimum of 2 weeks prior to application of air barrier membrane.

1.8 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries with construction schedule and arrange for proper storage areas.

.2 All materials are to be stored in a clean, dry and protected area in their original containers sealed and undamaged. Manufacturer's labels are to be easily visible and undamaged.

.3 Care and precaution are to be exercised by the Applicator so as not to damage the work of other trades. Applicator is responsible to take all necessary precautions to protect work of other trades during application.

.4 In addition to the above, store modified bituminous sheet type air and vapour barrier membrane as follows:

.1 Store rolls of membrane on end, in vertical position without leaning with selvage end up.

.2 Store materials away from direct heat or open flame.

.3 For installation in cold weather, store rolls of membrane in heated storage trailer for minimum of 24 hours with the temperature kept at 21°C and remove for application with as little exposure as possible to low ambient temperatures.

.5 Provide portable fire extinguishers within easy access of torching applications.

1.9 WARRANTY

.1 Manufacturer's Warranty: Submit Manufacturer's warranty stating that air and vapour membranes and accessories are free of defects and are manufactured to meet Manufacturer's published physical properties and material specifications as of the date of product delivery.

.2 Installer's Warranty: Submit Installers warranty stating that air and vapour membranes and accessories are installed in accordance with Manufacturer's recommendations and that membrane, transitions and through-wall flashing membranes, primers, mastics, adhesives and sealants are sourced from one Manufacturer.

2 Products

2.1 MATERIALS – GENERAL

.1 Source Limitations: Obtain primary air vapour barrier (AVB) materials and air vapour barrier accessories from single source from single Manufacturer.

2.2 AIR VAPOUR BARRIER (AVB) – SELF ADHESIVE SHEET MATERIALS

.1 Self-Adhesive Modified (Rubberized Asphalt) Bitumen Sheet Membrane:

.1 Field membrane, transition membrane and flashings (through wall flashings) Self-adhering membrane of rubberized-asphalt 0.8mm integrally bonded to high density, cross-laminated polyethylene film 0.1mm, formed into uniform flexible sheets of not less than 1mm total thickness, interleaved with disposable silicone-coated release paper until installed. Use regular or low-temperature variety for temperature ranges specified by Manufacturer. All related accessories such as primer, seam tape, mastic, fluid, and sealant shall be as recommended by, or provided by the same Manufacturer as the air/vapour barrier material used.

.1 Thickness: 1.0mm (40 mils).

.2 Air leakage: ASTM E283 - <0.01 L/s·m² @ 75 Pa.

.3 Water vapour permeance: ASTM E96 - 2.8 ng/Pa.m².s (0.05 perms).

.4 Low temperature flexibility: -30°C.

.5 Elongation: ASTM D412 - modified -200%.

.2 Manufacturer: Subject to conformance with the requirements of this Section, provide the following products by Henry Company Canada / Bakor, or an acceptable equivalent product named below:

.1 Self-Adhering Air/Vapour Barrier: 'Blueskin SA' and 'Blueskin LT'.

.2 Flashings: 'Blueskin TWF'.

.3 Acceptable Equivalent Products:

.1 ‘Sopraseal Stick 1100T’ summer grade / winter grade by Soprema.

.2 ‘ExoAir 110/110LT’ by Tremco.

.3 ‘Air Shield/Air Shield LT’ by W.R. Meadows Inc.

.4 Substitutions: Not Permitted.

.2 Accessories: Furnish auxiliary materials recommended by Manufacturer for intended use and compatible with air vapour barrier (AVB) membrane.

.1 Flashing to counter flash metal flashings refer to Section 07 62 00.

.2 AVB Transition Strip: Peel and stick membrane to transition between membranes.

.3 Primer: If required and as recommended by membrane Manufacturer for approved substrate, VOC compliant.

.4 Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes by membrane Manufacturer.

.5 Termination bars and fasteners: Galvanized steel, Stainless steel and stainless fasteners.

3 Execution

3.1 EXAMINATION

.1 Ensure that surfaces to receive air barrier membrane are dry, firm, suitable for bond, and free from dust, dirt, loose material, projections, ice, frost, slick, grease, oil or other matter detrimental to bond of sheet type air barrier membrane.

.2 Report surfaces left unacceptable by other trades in writing to the Consultant before commencing installation.

.3 Co-ordinate work of this Section with the work of other Sections.

.4 Commencement of work of this Section implies acceptance of surfaces and conditions.

3.2 PREPARATION

.1 Prepare surfaces in accordance with Manufacturer's written requirements for type of substrate; free from voids, spalled areas, loose aggregates or sharp points; clean surfaces to remove contaminants that could affect bond such as grease or wax, dust, dirt and debris.

.2 Apply primer to substrates when required by Manufacturer at rate recommended by Manufacturer; cover primed substrates on same day, reapply primer when work cannot be completed on the same day.

3.3 INSTALLATION

.1 Install air and vapour barrier membranes in accordance with Manufacturer's written requirements, using appropriate equipment and skilled workers and as follows:

.1 Transition Membranes: Connect air and vapour membranes to adjacent assemblies having pre-installed transition membranes; install transition membranes where required to maintain continuity of building envelope.

.2 Through Wall and Flexible Flashings: Install flexible membranes where required to maintain flow direction to divert water away from face of building envelope.

.2 Separate air and vapour barrier membranes from incompatible materials and provide Manufacturer's recommended transition materials required to maintain continuity of building envelope.

.3 Cut and tightly seal air and vapour barrier membrane around penetrations and protrusions to provide a continuous air barrier.

.4 Lap joints in air and vapour barrier membrane minimum of 75mm (3").

.5 Where masonry anchors and supports pass through air and vapour barrier membrane, ensure continuity of air and vapour barrier membrane by applying air barrier mastic all around/over masonry anchors.

.6 Prior to masonry being installed by Section 04 20 00, inspect air and vapour barrier membrane for punctures, misaligned seams and fishmouths. Apply additional layer of air and vapour barrier membrane over damaged/affected areas, extending membrane minimum of 152mm (6") beyond damage in all directions.

3.4 SITE QUALITY CONTROL

.1 Allow access for review and inspection and testing of installed air and vapour barrier membrane, and repair of deficiencies before placement of insulation materials.

.2 Manufacturer's Site Services: Arrange for air and vapour barrier membrane Manufacturer's technical personnel to review building envelope during installation.

.3 Owner reserves the right to engage a testing firm to perform air and vapour barrier membrane testing to confirm performance of installed membranes and insulation systems. Testing will be performed when the building mechanical systems are balanced and operating; when building is occupied, and climatic conditions are suitable for infrared thermographic scan of the building.

.4 Cooperate with testing agency; repair or replace air and vapour barrier membrane as directed by testing agency, at no additional cost to the Owner.

3.5 CLEANING AND PROTECTION

.1 Protection: Protect membrane as recommended by manufacturer from effects of long-term exposure where membrane is open to the environment for prolonged time periods using opaque plastic sheets or tarpaulins; protect membrane from penetrations and damage by successive components of the Work; assign payment for repairs to responsible parties; make repairs in accordance with Manufacturer's written instructions using original Installers.

.2 Cleaning: Remove masking materials, debris, excess materials and equipment from site at completion of the work; conduct ongoing daily cleaning as directed by the Contractor; clean stains, drips or spills of coatings, sealants, mastic or primers visible on finished surfaces.

END OF SECTION

1 General

1.1 SUMMARY

.1 Furnish labour, materials and other services to complete the fabrication and installation of;
- .1 Flashing at new door,
- .2 Break metal flashings where shown,
- .3 Prefinished flashings where indicated.

1.2 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):
- .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
- .2 ASTM C920, Standard Specification for Elastomeric Joint Sealants.

1.3 SUBMITTALS

.1 Provide submittals specified and as required to assess conformance with the Contract Documents, in accordance with the Contract Requirements, Contract General Requirements and Section 01 33 00.

.2 Submit shop drawings indicating material, thickness and finish.

.3 Submit duplicate 100mm x 100mm (4” x 4”) samples of each type of sheet metal material, colour and finish for review by Consultant prior to fabrication.

1.4 QUALITY ASSURANCE

.1 Fabricator and tradesmen executing the work of this Section shall have had a minimum 5 year continuous Canadian experience in successful manufacture and installation of Work of type and quality shown and specified. Submit proof of experience upon Consultant's request.

.2 Erection of metal flashing systems shall be by workmen especially trained and experienced in this type of work. Have a senior, qualified representative at the job site to direct the work of this Section at all times.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Store materials flat at site under protection to prevent staining from the work of other trades or from collection of water on material and secured against wind damage.

.2 Carefully store preformed sheet metal work in such a manner as to prevent twisting, bending and rubbing.

.3 Protect sheet metal work from corrosive materials and dissimilar metals.

1.6 WARRANTY

.1 Warrant the work of this Section against defects in materials and workmanship in accordance with General Conditions, but for a period of 2 years. Agree to

promptly make good defects which become evident during warranty period without cost to the Owner.

.2 Without restricting the generality of the Warranty, defects shall include deformation, buckling, leakage, weather tightness, failure of anchors and fastenings, failure of paint coating and sealants.

.3 Promptly make good defects and/or failures in the work of this Section upon written notification by the Owner that such exist. Remedy shall include labour, materials, equipment and services required to make good defective work, and to replace components and finishes and Owner's property damaged or disturbed in the course of remedying defects.

2 Products

2.1 MATERIALS

.1 Zinc Coated Steel Sheet: ASTM A653/A653M, commercial quality, with Z275 designation zinc coating, factory finished, minimum 0.89mm (0.0336”) base metal thickness.

.2 Nails, bolts screws and rivets: Material - galvanized steel, stainless steel or same metal as material to be fastened. Type – in accordance with approved samples.

.3 Isolation coating: Alkali and acid resistant bituminous paint.

.4 Zinc Rich Paint for Touch-up of Galvanized Metals: Ready mixed, zinc-rich primer conforming to CAN/CGSB-1.181, Zinc Clad No. 5 Organic Zinc Rich Primer by Sherwin Williams Company of Canada Ltd., or approved alternate.

.5 Field Touch-Up Paint: As recommended by factory finish material manufacturer.

.6 Underlay for metal flashing: Asphalt laminated 3.6 to 4.5kg kraft paper.

.7 Sealant: Multi-component, chemical curing epoxidized polyurethane type sealant conforming to ASTM C920: Dymeric 240FC by Tremco (Canada) Ltd., or approved alternate. Colour as selected later by Consultant. Provide primers, bond breakers and cleaning agents as recommended by the sealant Manufacturer.

.8 All other materials not specifically described but required for a complete and proper installation of the work of this Section shall be new first quality of their respective kinds and subject to the approval of the Consultant.

2.2 FABRICATION

.1 Fabricate metal flashings as detailed.

.2 Form flashings, and counter flashings as required to suit each condition. Use prefinished sheet steel in all locations. Form pieces in 2438mm (8'-0") maximum lengths. Make allowance for expansion at joints.

.3 Fabricate sheet metal components with lines, arises and angles sharp and true and plane surfaces free from objectionable wave, warp or buckle.

.4 Mitre and seal corners with sealant. Form drip edging at 45° angle, secure with a continuous 20 ga. hold-down clip.

.5 Exposed edges of sheet metal shall be folded back to form a 13mm (1/2") wide hem on the side concealed from view. Prefabricate corner pieces for flashings and copings. The workmanship and methods employed for forming, anchoring, cleating and the provision for expansion and contraction of sheet metal work shall be to the approval of the Consultant.

.6 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.7 Apply two coats of bituminous paint to metal surfaces to be in contact with masonry, concrete, mortar or dissimilar metals.

2.3 FINISHING

.1 Factory Finished Metal Sheets.

.1 Silicone Modified Polyester: Coating thickness: not less than 25 micrometres, custom colour.

3 Execution

3.1 EXAMINATION

.1 Inspect substrate surfaces on which the work of this Section is erected for any irregularities detrimental to the application and performance of the Work. Confirm conditions satisfactory before proceeding. Report to Consultant in writing, defects of work prepared by other trades and unsatisfactory site conditions. Commencement of work implies acceptance of surfaces and conditions.

3.2 INSTALLATION

.1 Metal flashing shall be in compliance with best sheet metal trade practice and shall in no way be contrary to sheet metal practice that will qualify for the Guarantee Certificate specified. Install with "S" lock expansion joints or standing seams incorporated on end of flashing length and all joints sealed with mastic.

.2 Provide continuous starter strips to present true, non-waving leading edge. Provide clips and anchor to backup in an approved manner to provide rigid, secure installation. Conceal fastenings in completed flashing. Lap, lock and seal all seams.

.3 Provide underlay under sheet metal. Secure in place and lap joints 100mm (4").

.4 Install sheet metal flashings as indicated on Drawings using flat lock seams. Make joints to permit thermal movement. Make surfaces free from buckling, warp, wave, dents, oil canning or other defects. Make corners square and surfaces straight and in true planes. Space seams not farther apart than 2439mm (8').

.5 All sheet and strip flashing to be held in place by 14-gauge galvanized iron clips of a size and type to be determined by the construction requirements, except where specifically detailed on the Drawings.

.6 Lock end joints and caulk with sealant.

.7 Use rubber-asphalt sealing compound for joints between sheet metal and bitumen.

.8 Supply rigid flashing, and sheet metal back-up to other trades where required to be built into other work at doors, and where shown on Drawings.

.9 Take careful note of fans, vents, etc., on mechanical Drawings to determine whether flashing and counter flashing is required or whether units are self-counter flashing.

.10 Caulking shall be installed as per written Manufacturer's recommendations.

.11 Exposed fastenings will be permitted where indicated or where concealed fastening is not possible. Obtain Consultant's approval of exposed fastenings and methods of making same.

.12 If exposed screws or bolts are used, use cupped neoprene washers.

3.3 CLEANING

.1 Remove, as the work progresses, all excess or foreign material which would set up or become difficult to remove from finished surfaces.

.2 Do all final cleaning upon completion of the Work of this Section. Leave building and Work in condition to meet the approval of the Consultant.

.3 Remove excess sealant by the moderate use of mineral spirits or other solvent acceptable by the sealant Manufacturer.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Systems comprising fireproof firestopping and smoke seal materials and accessories, at joints and penetrations in fire resistance rated wall, floor and roof assemblies, materials and components.

.2 Rated foam seal joint system.

.3 Manufacturer's site services and site quality control.

1.3 RELATED REQUIREMENTS

.1 Coordinate with Work of other Sections having a direct bearing on Work of this Section.

1.4 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Underwriters Laboratories of Canada (ULC):
- .1 CAN/ULC S115, Standard Method of Fire Tests and Firestop Systems
- .2 ULC XHEZC, GuideInfo – Firestop Systems

1.5 PERFORMANCE REQUIREMENTS

.1 Materials, accessories and application procedures listed by ULC, cUL, WHI (Intertek/Warnock Hershey) or OPL (Omega Point Laboratories) or tested in accordance with CAN/ULC-S115 to comply with building code requirements.

.2 Fire-Resistive Joint Systems:
- .1 Generally, use listed assemblies types F, FT, FH or FTH, as applicable.

.3 Firestopping Materials: CAN/ULC-S115 and ASTM E2307, and to achieve fire ratings indicated.

.4 Surface Burning of Exposed Materials: CAN/ULC-S102 with a minimum flame spread/smoke developed rating of 25/50.

.5 Engineering Judgment: Where there is no specific third party tested and classified firestop system available for a particular firestop configuration, provide an Engineering Judgment acceptable to the authority having jurisdiction.

1.6 SUBMITTALS FOR REVIEW

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

.2 Product Data: Provide data on product characteristics, performance and limitation criteria, and indicating construction details accurately illustrating Project conditions. Include descriptions sufficient for identification at Project site.

.3 System Design Listings: Submit system design listings including design designations, locations and illustrations, from a qualified testing and inspection agency applicable, to each firestop configuration.

.1 Where Project conditions require modification to a qualified testing agency's illustration for a particular firestopping system condition, submit illustration, with modifications marked, approved by firestopping Manufacturer's fire-protection Engineer as an engineering judgment or equivalent fire resistance rated assembly.

.4 Firestop System Engineering Judgments: When required for acceptance by the authority having jurisdiction, Firestop System Engineering Judgment submissions shall:

.1 Clearly indicate that the recommended firestop system is an engineering judgment;

.2 Identify the job name, project location and firm which the engineering judgment is issued to;

.3 Be prepared, stamped and signed by a Professional Engineer, specializing in fire protection and licensed to practice in the place of the work.

.4 Be presented in appropriately descriptive written form with or without detail Drawings where appropriate;

.5 Reference tested system(s) which the engineering judgment is based on;

.6 Include clear directions for the installation of the recommended firestop system;

.7 Include dates of issue and authorization signature as well as the issuer’s name, address and telephone number;

.5 Samples:

.1 Submit samples of each type of firestop and smokeseal material and accessory.

1.7 SUBMITTALS FOR INFORMATION

.1 Qualifications Data: For Manufacturer and Installer.

.2 Installation Data: Manufacturer's special preparation and installation requirements.

.3 Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

.4 Delegated Design Submittals: Design firestopping assemblies required by the Contract Documents to withstand fire ratings indicated and in accordance with the Ontario Building Code.

.1 Provide manufacturer’s standard listings where site conditions match standard assembly listing.

.2 Provide Manufacturers engineered judgement with acceptance by authorities having jurisdiction, signed and sealed by the Manufactures; fire protection Engineer where assembly does not match standard assembly listing.

.5 Manufacturer's Field Reports: Indicate environmental conditions under which fireproofing materials were installed. Compatibility and Adhesion Test Reports: From Manufacturer indicating the following:
- .1 Materials have been tested for bond with substrates.
- .2 Materials have been verified by Manufacturer to be compatible with substrate.
- .3 Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.8 QUALITY ASSURANCE

.1 Applicator shall be licensed by the Manufacturer of fireproofing materials.
- .1 Accredited Canadian members of the Firestop Contractors International Association (FCIA).
  - .1 Certified installer listed under the ULC's Qualified Firestop Contractor Program.

.2 Submit Manufacturer's certification that materials meet or exceed specified requirements.

.3 Maintain flame and temperature ratings equal to surrounding materials.

.4 Single Responsibility: Perform work using single applicator having undivided responsibility for entire Project, including coordination with plumbing, mechanical and electrical installations.

.5 Single Source Responsibility: Obtain firestop systems for each type of penetration and construction situation from a single primary firestop systems Manufacturer.

1.9 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Deliver materials in original, unopened packages bearing name of Manufacturer and product identification.

.2 Store materials off ground, under cover, and away from damp surfaces.

1.10 SITE CONDITIONS

.1 Conform to Manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.2 Provide ventilation to Manufacturer's instructions in areas to receive solvent cured materials.

2 Products

2.1 FIRESTOP MANUFACTURERS

.1 Subject to compliance with requirements provide products of one of the following Manufacturers:
- .1 3M Fire Protection Products.
- .2 Hilti Canada Ltd.
- .3 Specified Technologies Inc.

.4 Tremco Inc.

2.2 FIRESTOP SYSTEMS

.1 Provide firestop systems to follow ULC XHEZC GuideInfo – Firestop Systems:
- .1 Head of Wall Joint Firestop Systems: XHEZC.HW
- .2 Joint Firestop Systems: XHEZC.JF
- .3 Perimeter Joint Firestop Systems: XHEZC.PJ
- .4 Service Penetration Firestop Systems: XHEZC.SP
- .5 Service Penetration for Combustible Systems: XHEZC.SPC

2.3 FIRESTOP MATERIALS

.1 Cementitious Matrixes: Minimum 2758 kPa (400 psi) compressive strength when cured, to retard cable tray warping within the firestop seal.

.2 Elastomeric Assemblies: Flexible, elastomeric seal suitable to withstand the required movement and capable of returning to original configuration without damage to seal and without adhesive or cohesive failure.

.3 Primers: Manufacturer's standard for specific material, substrate, and end use.

.4 Water (if applicable): Potable, clean and free from injurious amounts of deleterious substances.

.5 Damming and Backup Materials, Supports and Anchoring Devices: To Manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

.6 Pipe and Duct Insulation and Wrappings: Compatible with firestopping systems.

.7 Intumescent Pads: Permanently pliable type.

.8 Intumescent Composite Sheet: Composite sheet, strip or precut shapes.

.9 Sealants and Putty for Vertical and Overhead Joints: Non sagging.

.10 Sealants and Fluid Seals at Floors: Self levelling.

.11 Identification Labels: Minimum 75mm x 100mm (3” x 4”) permanent self-adhering or mechanically retained corrosion resistant metal labels, with black text on yellow background.

.12 Indicate ULC or cUL firestopping system number, rating, products used, and contact information of installers.

2.4 RATED FOAM SEAL JOINT SYSTEM

.1 Rated Foam Seal: Silicone pre-coated, preformed, pre-compressed, waterproof, self-expanding, size and fire rated requirement as indicated on Drawings, movement +/- 50% accommodation to design. Sealant system shall be comprised of the following components:
- .1 Apply foam seal with epoxy adhesive primer.
- .2 Maintain continuous air/vapour and moisture barrier in conjunction with adjacent existing air/vapour barrier systems.
- .3 Acceptable Product:
  - .1 EMSHIELD Series by Emseal.

.4 Colour:
.1 Non-exposed joints: Standard Grey.
.2 Exposed joints: Custom colour to match adjacent finishes.

2.5 ACCESSORIES

.1 Provide components for each firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components recommended by firestopping manufacturer in accordance with tested assembly being installed, and acceptable to authorities having jurisdiction.

.2 Primer: Type recommended by firestopping Manufacturer for specific substrate surfaces.

.3 Dam Material: Permanent:
.1 Mineral wool board: Minimum 64kg/m³ density, non-combustible, flame spread of 0, smoke development of 0 to ULC S102.
.2 Mineral wool batt: Minimum 32kg/m³ density, non-combustible, flame spread of 0, smoke development of 0 to ULC S102.
.3 Alumina silicate fire board.
.4 Sealants used in combination with other forming, damming and backing materials to prevent leakage of fill materials in liquid state.
.5 Fillers for sealants.

.4 Installation Accessories: Clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

.5 Water: Potable, clean and free from injurious amounts of deleterious substances.

2.6 FINISHES

.1 Colour: Red unless otherwise noted.

3 Execution

3.1 EXAMINATION

.1 Verify existing conditions before starting work.

.2 Verify opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping are ready to receive the work of this Section.

.3 Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.

.2 Remove incompatible materials which may affect bond.

.3 Install backing and damming materials to arrest liquid material leakage.

.4 Mask adjacent surfaces to protect from spillage and over coating; immediately remove material from adjacent surfaces.

3.3 APPLICATION

.1 Apply primer and materials to Manufacturer's written instructions, approved tested assemblies and details.
  .1 Provide materials to maintain the fire separations in the project as indicated on the Drawings.

.2 Install material at walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

.3 Apply firestopping material in sufficient thickness to achieve rating and to uniform density and texture.

.4 Tool or trowel exposed surfaces to a uniform finish.

.5 Compress fibred material to achieve a density of 25-40% of its uncompressed density required for listed system.

.6 Place material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

.7 Place intumescent coating in sufficient coats to achieve rating required.

.8 Remove dam material after firestopping material has cured. Dam material to remain.

.9 Provide identification labels as specified.

.10 In non-fire rated construction indicated to prevent smoke movement, tightly pack voids of service penetrations and around openings with mineral wool insulation and sealant.

3.4 IDENTIFICATION

.1 Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, prepreinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
  .1 The words: "Warning: Through-Penetration Firestop System - Do Not Disturb"
  .2 Contractor's name, address and telephone number.
  .3 Designation of applicable testing and inspection agency.
  .4 Date of installation.
  .5 Manufacturer's name for firestop materials.

3.5 MANUFACTURER'S SITE SERVICES

.1 Require site attendance of firestopping product Manufacturer during installation of the Work. Schedule Manufacturer’s review of work procedures at stages listed:
  .1 Pre-installation Meeting: 1 review at Site and meeting with authorized Installers.

.2 Installation: 3 reviews at Site: 1 at commencement of Work; 1 at 50% completion of Work; 1 upon completion of Work.

.2 Submit Manufacturer's written reports to Consultant describing:
- .1 The scope of work requested.
- .2 Date, time and location.
- .3 Procedures performed.
- .4 Observed or detected non-compliances or inconsistencies with Manufacturers' recommended instructions.
- .5 Limitations or disclaimers regarding the procedures performed.
- .6 Obtain reports within three days of review and submit immediately to Consultant.

.3 Monitor and report installation procedures and unacceptable conditions.
- .1 Inspect and review materials and workmanship including storage, handling and protection. Advise Consultant and Owner 48 hours in advance of inspections.
- .2 Correct identified defects or irregularities.

.4 Remove and replace unacceptable firestopping assemblies.

3.6 CLEANING

.1 Clean installed work.

.2 Clean adjacent surfaces of firestopping materials.

3.7 PROTECTION OF FINISHED WORK

.1 Protect installed work.

.2 Protect adjacent surfaces from damage by material installation.

3.8 SCHEDULE

.1 Firestop the following conditions and as indicated:
- .1 Penetrations through fire resistance-rated construction.
- .2 Tops of fire resistance rated walls.
- .3 Intersections of fire resistance rated walls and non-fire rated walls.
- .4 Control joints in fire resistant rated construction.
- .5 Joints at exterior wall/floor intersections.
- .6 Openings and sleeves installed for future use through fire resistant rated separations.
- .7 Non-fire rated construction to prevent smoke movement. Pack void space at all service penetrations and other openings with either tightly packed mineral wool dam material, or sealant, or a combination of both. The sealant need not be rated.

.2 Rated foam seal joint in rated assemblies including:
- .1 Rated foam seal joint at fire rated expansion joint location where fire resistance rating is required.
- .2 Expansion joints in concrete masonry units.

.3 Service Penetrations shall include but not limited to:
- .1 Mechanical Pipe Penetrations

.2 Mechanical Damper Joints: Top only in floor dampers
.3 Electrical Service Penetrations: Bus duct, etc.
.4 Electrical Outlet Boxes: Receptacles, switches etc., in fire-rated GWB only.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Sealants and joint backing.

.2 Acoustic sealants.

.3 Compressible seals.

.4 Site quality control and manufacturer's site services.

1.3 RELATED REQUIREMENTS

.1 Coordinate with Work of other Sections having a direct bearing on Work of this Section.

1.4 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM C509, Standard Specifications for Elastomeric Cellular Performed Gasket and Sealing Material.

.2 ASTM C510, Standard Test Method for Staining and Color Change of Single-or Multicomponent Joint Sealants.

.3 ASTM C920, Standard Specification for Elastomeric Joint Sealants.

.4 ASTM C1021, Standard Practice for Laboratories Engaged in Testing of Building Sealants.

.5 ASTM C1184, Standard Specification for Structural Silicone Sealants.

.6 ASTM C1193, Standard Guide for Use of Joint Sealants.

.7 ASTM C1248, Standard Test Method for Staining of Porous Substrate by Joint Sealants.

.8 ASTM C1330, Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.

.9 ASTM D5893/D5893M, Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.

1.5 SUBMITTALS

.1 Provide submittals in accordance with the General Conditions and Section 01 33 00.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Manufacturer's Data: Submit Manufacturer's literature describing each material to be used in the work of this Section. Literature shall contain a statement that the material complies with the specified standard.

.2 Structural Sealant Joint Design: Provide calculations for structural bite, dead load support, glueline thickness, shear, and other parameters. Include confirmation that design data provided by Consultant have been reviewed and approved by sealant Manufacturer.

.3 Samples: Submit for approval and colour selection sample of each type of compound, recommended primers and joint filler or fillers proposed to be used.

.3 Submittals for Information:

.1 Qualifications Data: For Manufacturer and Installer.

.2 Installation Data: Manufacturer's special installation requirements.

.1 Indicate special procedures, surface preparation, perimeter conditions requiring special attention, and field quality control testing.

.3 Field reports.

.1 Site quality control report identifying procedures for site testing and verification.

.2 Manufacture site service report identifying materials have been installed in accordance with Manufactures recommendations.

1.6 QUALITY ASSURANCE

.1 Applicator qualifications:

.1 Execute Work by Applicators trained and approved by the Manufacturer and having 5 years proven experience.

.2 Manufacturer’s representative:

.1 Review Site conditions, joint design, and Installer’s qualifications. Report unsatisfactory conditions to Consultant.

.2 Check container labels, inspect preparation of substrate materials and review installation procedures 48 hours in advance of installation, and randomly test installed Work.

.3 Pre-installation meetings:

.1 Conduct meetings 7 Days in advance of sealant installation.

.2 Include Consultant, sealant Manufacturer’s representative, independent inspection and testing agency engaged by Contractor, and parties who are directly affected by the Work of this Section.

.3 Verify Contract requirements, substrate conditions, joint conditions and profile, weather conditions, and the Manufacturer’s installation instructions.

.4 Within 72 hours following the pre-installation meeting, prepare a pre-installation meeting report and issue to all parties in attendance.

.1 Clearly indicate the recommendations made during the pre-installation meeting, the required actions, and by whom.

1.7 SITE CONDITIONS

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

1.8 DELIVERY, STORAGE HANDLING AND PROTECTION

.1 Deliver all materials to the jobsite in their original, unopened containers, with all labels intact.

.2 Receive and store materials as recommended by materials Manufacturer.

.3 Maintain containers and labels in undamaged condition.

1.9 WARRANTY

.1 Provide a 5 year warranty to include coverage for failure to meet specified requirements.
- .1 Include coverage for installed sealants and accessories which fail to achieve airtight seal, watertight seal, and exhibit loss of adhesion or cohesion, or do not cure.

.2 Provide Manufacturer's 20 year material warranty for installed silicone sealant.

2 Products

2.1 MATERIALS – INTERIOR SEALANTS

.1 Non-Traffic Locations:
- .1 Silicone Sealant: Single component, conforming to ASTM C920 Type S, Grade NS, use NT.
- .2 Product: Subject to compliance with requirements of this Section provide one of the following products:
  - .1 Spectrem 3 by Tremco Sealants.
  - .2 DOWSIL 795 by Dow.

.2 Non-Traffic Locations requiring Paintable Sealant:
- .1 Latex Joint Sealant, Paintable: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP Grade NF; single component, non-sagging, non-staining, non-bleeding.
- .2 Product: Subject to compliance with requirements of this Section provide one of the following products:
  - .1 Tremflex 834 by Tremco Sealants.
  - .2 MasterSeal NP 520 by Master Builders Solutions.
  - .3 AC-20+ Silicone by Pecora Corporation.

.3 Traffic Locations:
- .1 Polyurethane Sealant: Single component, self-levelling, conforming to ASTM C920, Type S Grade P, Use T, class 25.
- .2 Product: Subject to compliance with requirements of this Section provide one of the following products:
  - .1 Sikaflex 1CSL by Sika Canada Inc.
  - .2 MasterSeal SL-1 by Master Builders Solutions.
  - .3 Urexpan NR-201 by Pecora Corporation.
  - .4 Vulkem 45SSL by Tremco Sealants.
  - .5 Novalink SL by ChemLink.

.4 Control Joints in Ceramic Tile and Hard Surfaces in Washrooms, and around Plumbing Fixtures:

.1 Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25, Uses NT; G and O, single component, non-sagging, non-staining, mildew resistant; formulated with fungicide; colour as selected.

.2 Product: Subject to compliance with requirements of this Section provide one of the following products:

.1 Tremsil 200 by Tremco Sealants.

.2 DOWSIL 786 Sealant by Dow (for all applications except floors).

.3 DOWSIL Tub, Tile & Ceramic Silicone Sealant by Dow.

2.2 EXTERIOR SEALANTS

.1 Exterior Joints to Perimeters of Openings: Select one of the following to suit requirements of condition indicated.

.1 Silicone Sealant: Single component, 100% silicone rubber, medium modulus, moisture-curing, non-sagging, non-staining, non-bleeding; colours as selected; ASTM C920, Grade NS, Class 50 and complying with the following:

.1 SWRI Certificate of Validation.

.2 Modulus @ 50% Extension, ASTM C1135: Maximum 55 psi.

.3 Elongation Capability, ASTM D412: Minimum 235%.

.4 Stain Free Performance, ASTM C1248: No staining.

.5 Shore A Hardness: Range 15 to 35.

.6 Product: Subject to compliance with requirements of this Section provide one of the following products:

.1 DOWSIL 791 by Dow(for paint-finished metal surfaces).

.2 DOWSIL 795 by Dow (for anodic-finished metal surfaces).

.3 SCS2700 SilPruf LM or SCS2000 SilPruf by GE Silicones.

.4 Spectrem 2 by Tremco Sealants.

.2 Silicone Sealant: Single component, 100% silicone rubber, low modulus, moisture-curing, non-sagging, non-staining, non-bleeding; colours as selected; ASTM C920, Grade NS, Class 100/50 and complying with the following:

.1 SWRI Certificate of Validation.

.2 Modulus @ 50% Extension, ASTM C1135: Maximum 25 psi.

.3 Stain Free Performance, ASTM C1248: No staining.

.4 Shore A Hardness Range: 15 to 20.

.5 Product: Subject to compliance with requirements of this Section provide one of the following products:

.1 DOWSIL 790 by Dow.

.2 SCS2700 SilPruf LM by GE Silicones.

.3 Spectrem 1 by Tremco Sealants.

2.3 COMPRESSIBLE SEAL

.1 Acoustic compressible seals:

.1 Preformed Foam Joint Sealant: Manufacturer's standard. Preformed, pre-compressed, open-cell foam sealant manufactured from urethane foam. Factory produce in pre-compressed sizes in roll or stick form to fit joint widths indicated.

.2 Acoustic compressible seals: coated on 2 sides for joints between opaque surfaces, coated on 3 sides for compression against clear surfaces.

.3 Product:
.1 At opaque materials: QuietJoint SHH by Emseal Corporation, or approved alternate.
.2 At clear materials: QuietJoint SHG by Emseal Corporation, or approved alternate.

2.4 ACOUSTIC SEALANT

.1 To ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.2 Product: Subject to compliance with requirements of this Section provide one of the following products:
.1 CP-506 by Hilti.
.2 Sheetrock Brand Acoustical Sealant by USG.
.3 AC-20 FTR or AIS-919 by Pecora; product as recommended by manufacturer for application indicated.

.3 Accessories: As recommended by manufacture to achieve minimum STC rating listed.

2.5 ACCESSORIES

.1 Primers:
.1 Type recommended by sealant Manufacturer for substrate, to promote adhesion and to prevent staining of adjacent surfaces for conditions encountered.

.2 Joint backing:
.1 Extruded, round, solid section, skinned surface, closed cell, soft polyethylene foam gasket stock, compatible with primer and sealant materials.
.2 30% to 50% oversized.
.3 Shore A hardness of 20, tensile strength 140 kPa to 200 kPa, in accordance with ASTM C1330.
.4 Bond breaker type surface.

.3 Bond breaker tape:
.1 Polyethylene tape or other plastic tape recommended by sealant Manufacturer to prevent sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint.
.2 Provide self-adhesive, pressure sensitive tape where applicable.
.3 Do not use material impregnated with oil, bitumen, non-curing polymer or similar deleterious material.

.4 Cleaning agents:
.1 Recommended by sealant Manufacturer.
.2 Free of oily residues or other substances capable of staining or harming joint substrates and adjacent surfaces.

.5 Masking tape:
.1 Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

3 Execution

3.1 INSPECTION

.1 Verify at site that joints and surfaces conditions provided will not adversely affect execution, performance or quality of completed work.

.2 Ensure masonry and concrete have cured 28 days minimum.

.3 Ascertain that sealers and coatings applied to substrates are compatible with sealant used and that full bond of the sealant and substrate is attained. Request samples of the sealed or coated substrate from their fabricators for testing of compatibility and adhesion, if necessary.

.4 Verify that specified recommended environmental conditions are present before commending work.

.5 Defective work resulting from application to unsatisfactory joint conditions will be considered the responsibility of those performing the work of this Section.

.6 Do not start work of this Section until conditions are satisfactory.

3.2 PREPARATION

.1 Clean joint surfaces using joint cleaner as necessary, to remove dust, paint, loose mortar, and other foreign matter and dry joint surfaces.

.2 Remove dust, silt, scale and coatings from ferrous metals by wire brush, grinding or sandblasting.

.3 Remove oil, grease and other coatings from non-ferrous metals with approved cleaning solvent.

.4 Ensure surfaces are free of frost, rust, lacquers, laitance, release agents, moisture or other matter which might adversely affect adhesion of sealant.

.5 Examine joint sizes and correct as required to allow for anticipated movement and to achieve proper width/depth ratio per Manufacturer's written recommendations for specified sealant.

.6 Support joint filler on horizontal traffic surfaces against vertical movement which might result from traffic loads or foot traffic.

.7 Prepare surfaces as recommended by sealant Manufacturer.

.8 Fully remove existing sealant scheduled to be removed and replaced with new sealant, in areas indicated on the Drawings.

.1 Follow Manufacturers procedures for removal of existing sealant and test areas for adhesion of new sealant. Provide the Consultant with field report identifying results of adhesion testing.

.9 Install joint backing material or apply bond breaker tape to achieve correct joint depth and prevent three-sided adhesion.

.10 To protect adjacent surfaces, mask adjacent surfaces with tape prior to priming and/or sealing.

.11 Prime sides of joints using two cloth method in accordance with Manufacturer's directions immediately prior to sealing.

.12 Before any sealing is commended, a test of the material shall be made for indications of staining, poor adhesion or other undesirable effects.

.13 Seal joints in surfaces to be painted before painting. Where surfaces to be sealed are prime painted in shop before sealing, check to make sure prime paint is compatible with primer and sealant. If incompatible inform Consultant, consult the Manufacturer, and change primer and sealant to approved compatible types.

.14 Check form release agent used on concrete for compatibility with primer and sealant. If incompatible inform Consultant and change primer and sealant to approved compatible types or clean concrete to Consultant's approval.

3.3 INSTALLATION

.1 Perform Work in accordance with Manufacturer’s recommendations for Products and applications indicated, unless more stringent requirements apply.

.2 Use Products without additives or adulteration. Use one Manufacturer's Product for each location in accordance with Sealant Location Schedule at end of this section.

.3 Perform Work in accordance with ASTM C1193, and ASTM C919 for Acoustic Sealant.

.4 Joint backing:

- .1 Install joint backing to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - .1 Depth of recess: Maintain 2:1 joint width to depth ratio.
  - .2 Where recess is less than specified depth, cut back surface of recess to specified depth.
- .2 Do not leave gaps between ends of joint backings.
- .3 Do not stretch, twist, puncture, or tear joint backings.
- .4 Remove absorbent joint backings that have become wet before sealant application and replace with dry materials.
- .5 Support joint backing on horizontal surfaces against vertical movement which might result from pedestrian or vehicular traffic loads.

.5 Install bond breaker tape between sealant and back of joints where joint backing is not used.

.6 Apply sealant immediately after adjoining Work is in condition to receive sealant Work and as follows:

- .1 Apply sealant in a continuous bead using gun with correctly sized nozzle. Use sufficient pressure to completely fill joint recess.
- .2 Ensure sealant has full, direct uniform contact with, and adhesion to, side surfaces of recess. Superficial pointing with skin bead is not acceptable.

.7 Tooling:

- .1 Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified to form smooth, uniform sealant bead, free from ridges, wrinkles, sags, air pockets, embedded impurities, dirt, stains, or other defects.

.2 At recesses in angular surfaces, finish sealant with flat profile, flush with face of material at each side.

.3 At recesses in flush surfaces, finish sealant with concave face and flush with face of material at each side.

.8 Immediately remove excess sealant and droppings.

.9 Ensure sealant bead is uniform in colour.

.10 Cure in accordance with the sealant manufacturer's recommendations. Do not cover up sealants until proper curing has taken place.

.11 Remove defective sealant and reapply.

3.4 SITE QUALITY CONTROL

.1 Joint Sealants: Perform adhesion tests on exterior sealants in accordance with Manufacturer's written instructions and ASTM C1193, Method A – Field-Applied Sealant Joint Hand Pull Tab.

.1 Perform test no later than 21 days after installation at a rate of one test every 300m of installed sealant.

.2 Remove sealants failing adhesion test, clean substrates, reinstall sealants and perform retesting.

.3 Maintain test log and submit report to Consultant indicating tests, locations, dates, results, and remedial actions.

.4 Maintain record of conditions and temperatures during application.

3.5 CLEANING

.1 Clean surfaces adjacent to joints. Immediately remove sealant smears or other soiling resulting from application of sealants.

.2 Remove masking tape and other residue.

.3 Do not mar or damage finishes on materials adjacent to joints. Repair or replace marred or damaged materials.

3.6 PROTECTION

.1 Protect joint sealants:

.1 During and after curing period from contact with contaminating substrates.

.2 From damages by construction operations or other causes.

.2 If damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated sealants immediately.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of the following:
- .1 Exterior and Interior Steel Doors
- .2 Exterior and Interior Steel Door Frames
- .3 Fire rated door and frame assemblies

1.3 RELATED REQUIREMENTS

.1 Section 04 20 00
.2 Section 07 92 00
.3 Section 08 70 00
.4 Section 08 80 00
.5 Section 09 90 00

1.4 DEFINITIONS

.1 Base Metal Thickness: Thickness dimensions are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metallic coated steel sheets.

.2 Opening Sizes: Metric door sizes indicated in on Drawings are considered nominal dimensions, measured from frame rabbet width and height, with allowances for nominal clearances between head, jamb and door bottom in accordance with CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames.

1.5 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 American National Standards Institute (ANSI):
- .1 ANSI/SDI A250.7, Nomenclature for Standard Steel Doors and Steel Frames
- .2 ANSI/SDI A250.11, Recommended Erection Instructions for Steel Frames.

.3 American Society for Testing and Materials (ASTM):
- .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM A879/A879M, Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
- .3 ASTM A924/A924M, Standard Specification for General Requirements for Sheet Steel, Metallic-Coated by the Hot-Dip Process.

.4 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB 1.13, Primer, Zinc Chromate, Low Moisture Sensitivity.
- .2 CAN/CGSB 41-GP-19Ma, Rigid Vinyl Extrusions for Windows and Doors
- .3 CAN/CGSB 82.5, Insulated Steel Doors

.5 Canadian Standards Association (CSA):
- .1 CSA W59, Welded Steel Construction (Metal Arc Welding)

.6 Canadian Steel Door Manufacturers Association (CSDMA):
- .1 Recommended Dimensional Standards for Commercial Steel Doors and Frames
- .2 Fire Labelling Guide

.7 National Fire Protection Association (NFPA):
- .1 NFPA 80, Fire Doors and Windows
- .2 NFPA 252, Fire Tests of Door Assemblies

.8 Underwriters Laboratories Canada (ULC):
- .1 CAN4 S104, Fire Tests of Door Assemblies
- .2 CAN/ULC S105, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC S104
- .3 CAN4 S106, Standard Method for Fire Tests of Window and Glass Block Assemblies

1.6 SUBMITTALS

.1 Provide requested information in accordance with Section 01 33 00.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:
- .1 Product Data:
  - .1 Submit product data for each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, fire resistance ratings, and finishes.
- .2 Shop Drawings:
  - .1 Show each type of frame, door, hardware blanking, reinforcing, tapping and drilling arrangements, metal gauges, thicknesses and finishes.
  - .2 Show details of doors including vertical and horizontal edge details.
  - .3 Submit door and frame schedule identifying each unit. Each unit shall bear a legible identifying mark corresponding to that listed in the door and frame schedule.
- .3 Samples:
  - .1 Supply for Consultant's review, if requested, sample of frame corner showing construction, workmanship and finish.
- .4 Informational Submittals: Provide the following submittals when requested by the Consultant:
  - .1 Source Quality Control Submittals: Submit information on zinc coating treatment and primer spot treatment, including instructions for surface treatment before site painting and any restrictions or special coating requirements.

.5 Certificates: Submit the following certificates or letters of compliance:
.1 Oversize Compliance: Submit oversize construction evidence indicating compliance with fire labelling for door and frame assemblies required to be fire protection rated and exceeding size limitations of labelled assemblies.

1.7 QUALITY ASSURANCE

.1 Manufacturer: Obtain hollow metal doors and frames from single source of supply and from a single Manufacturer, and as follows:
.1 Fabricate work of this Section to meet the requirements of the Canadian Steel Door and Frame Manufacturer's Association, Manufacturing Specification for Doors and Frames as a minimum, and as further modified in this Section.
.2 Fabricator shall be a member in good standing of the Canadian Steel Door and Frame Manufacturer's Association.

.2 Supplier: Obtain hollow metal doors and frames from single source of supply and from a single Manufacturer.

.3 Installer: Use Installers who are experienced with the installation of hollow metal doors and frames of similar complexity and extent to that required for the Project.

.4 Testing Agencies: Provide doors produced under label service program of a testing agency acceptable to authorities having jurisdiction, and as follows:
.1 Steel Fire Rated Doors and Frames: Labelled and listed by an organization accredited by Standards Council of Canada for ratings specified or indicated.
.2 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled:
.1 List by nationally recognized agency having factory inspection service and construct as detailed in Follow-up Service Procedures/Factory Inspection Manuals issued by listing agency to individual Manufacturers.
.2 Fabricate all rated doors, frames and screens to labelling authority standard.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off-the-ground, under cover storage location. Do not load any area beyond the design limits.

.2 Adequately protect units against rust and damage during manufacture, delivery and storage.

.3 Store materials on planks in a dry area and cover to protect from damage. Make good immediately any damage done. Clean scratches and touch-up with rust-inhibitive primer.

1.9 SITE CONDITIONS

.1 Site Measurements: Verify actual dimensions of openings by site measurements before fabrication and indicate measurements on shop drawings; coordinate fabrication schedule with construction progress to avoid delaying the Work.

.2 Established Measurements: Establish dimensions and proceed with fabricating doors and frames without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual site dimensions correspond to established dimensions.

2 Products

2.1 MATERIALS

.1 Sheet Steel:
- .1 Exterior Doors and Frames: Metallic Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum ZF180 (A60) zinc-iron-alloy (galvannealed) coating designation.
- .2 Interior Doors and Frames: Metallic Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum ZF120 (A40) zinc-iron-alloy (galvannealed) coating designation.

.2 Gauges:
- .1 Door and Screen Frames:
  - .1 Gauge: 1.60mm (16 msg)
- .2 Doors (Honeycomb or Polystyrene Core):
  - .1 Door Faces:
    - .1 Gauge: 1.30mm (18 msg).
- .3 Top and Bottom End Channels:
  - .1 Gauge: 1.30mm (18 msg).
- .4 Reinforcements:
  - .1 Lock and Strike Reinforcements:
    - .1 Gauge: 1.60mm (16 msg).
  - .2 Hinge Reinforcements:
    - .1 Gauge: 3.51mm (10 msg).
  - .3 Flush Bolt Reinforcements:
    - .1 Gauge: 1.60mm (16 msg).
  - .4 Door Closer or Holder Reinforcements:
    - .1 Gauge: 2.74mm (12 msg).

.3 Anchors:
- .1 As required to suit condition.

.4 Rubber Bumpers:
- .1 3 per door.

.5 Weatherstrip:
- .1 Refer to Section 08 70 00.

.6 Door Cores:
- .1 Honeycomb Core: Structural small cell; 25mm (1”) maximum, kraft paper honeycomb; minimum weight 36kg/ream; minimum density 16.5kg/m^3; sanded to required thickness.

.2 Insulation Core: Semi rigid, CAN/ULC S702, Type 1 mineral wool insulation, meeting CAN/ULC S102 flame spread index and Smoke developed index.

.7 Adhesives:
.1 Core Adhesive: Heat resistant, single component adhesive recommended by Manufacturer.

.8 Foam-In-Place Insulation: CFC free polyurethane foam, moisture cure sealant insulation, 16kg/m^3 to 32kg/m^3 density; injected from prepackaged pressurized containers; Enerfoam by Dow Chemical, IPF by Rivenco Industries Ltd., or Zerodraft by Canam Building Envelope Specialists.

.9 Touch-Up Primer: Rust inhibitive primer meeting CAN/CGSB 1.132, touch up zinc coatings using shop applied primer; grey or red coloured primer, clear primer not acceptable; provide additional primer for site touch-up to repair damaged zinc and shop applied coatings.

.10 Accessories:
.1 Glazing Stops:
.1 Glass mouldings: Formed steel having 0.8mm (1/32”) metal core thickness, screw fixed.
.2 Accurately fit and butt at corners glazing trim and stops; located on secure side of door, or interior of room window frame.
.2 Sealant: As specified in Section 07 92 00.
.3 Glass and Glazing: As specified in Section 08 80 00.
.4 Door Silencers (Bumpers or Mutes): Manufacturer’s standard black or grey neoprene silencers; three silencers on strike jambs of single door frames; two silencers on heads of double-door frames; stick on bumpers are not acceptable.

.11 Materials for fire rated doors shall conform to ULC or ULI requirements.

2.2 FABRICATION AND MANUFACTURE

.1 Gauges of metal shall be as specified. No deviations or substitutions will be accepted.

.2 Reinforcing specified is the minimum acceptable. Provide additional reinforcement where required to ensure a permanent, rigid, trouble-free installation able to withstand the stresses of heavy commercial usage.

.3 Cut, shear, straighten and work the steel in manner to prevent disfigurement of the finished work.

.4 Punch frames for rubber door bumpers.

.5 Fill seams, joints and weld depressions with epoxy metal filler, disc sand to a smooth, flat, uniform scratch-free surface, with all arises sharp and true to line. Drilled and punches holes shall be reamed and have all burrs removed.

.6 Finished work shall be free of warp, open seams, buckles, weld and grind marks and other surface defects detrimental to the production of a good paint finish.

.7 Fastenings shall be concealed except those required for loose glazing stops.

.8 Welding shall conform to CSA W59-03 (R2008).

.9 Hardware Requirements:

.1 Blank, mortise, reinforce, drill and tap doors and frames to receive templated hinges and other hardware as required. Check hardware lists for requirements.

.10 Frames:

.1 Fabricate frames to profiles shown. Frames shall be fabricated to suite the header conditions of masonry work. Mitre corners of frames. Cut frame mitres accurately and weld continuously on inside of frame. Fabricate header frame to suit. Where site welding or splicing is required due to size of unit, the location of field joints shall be shown on the shop drawings and strictly adhered to.

.2 Protect strike and hinge reinforcements and other openings with mortar guard boxes welded to frame.

.3 Cut-outs in doors for mortise lock sets shall be fitted with leaf spring clips and back limit stop to facilitate easy positioning and setting of locksets.

.4 Weld floor clip angles to inside of each jamb profile, two holes in each for anchorage to floor. Where required provide adjustable type floor clip angles.

.5 Fit frames with channel or angle spreaders, two per frame, to ensure proper frame alignment. Install stiffener plates or spreaders between frame trim where required, to prevent bending of trim and to maintain alignment when setting and during construction.

.6 Where frames occur in masonry provide and adjustable T-strap type or wire type anchor for every 610mm (2'-0") of jamb length. Special anchors for frames to be set in concrete shall be as detailed.

.7 Construct door frames of labelled fire doors as approved by ULC or ULI. Ratings for frames shall match doors. Locate label on the frame jamb midway between the top hinge and the head of door frame so that it is concealed when the door is closed.

.8 Provide continuous weatherstripping at head and jambs of exterior door frames. Properly secure in place with screws and adjust as required.

.9 Insulate exterior frames to provide continuous thermal barrier in exterior frames. Completely fill frame space with foam-in-place insulation.

.11 Doors:

.1 Fabricate doors to present one continuous face free from joints, tool markings and abrasions.

.2 Reinforce, stiffen honeycomb doors with small cell honeycomb core laminated to the inside faces of panels. The core shall completely fill the inside hollow of the door.

.3 Reinforce around frame openings required for glazing or louvers. Provide glazing stops with countersunk oval head screws.

.4 Exterior doors shall be completely filled with polystyrene foam core.

.5 Reinforce door edges with channel reinforcing. Bevel stiles 3mm (1/8"). Assemble by tack welding and fill.

.6 Provide flush top edge on exterior doors.

.7 Fabricate fire rated door assemblies in accordance with ULC or ULI requirements. Provide labels for all fire rated doors. Locate label on the

door midway between the top hinge and the head of the door so that it is concealed when the door is closed.

.8 Provide cut-outs in doors for glazed lites as indicated on Drawings and schedules. Glazing stops shall be square formed steel in single piece lengths sized to suit. Accurately mitre corners and finish in proper plane. Secure stops in place with flush, countersunk screws.

.12 Finishing

.1 Shop apply zinc rich primer to repair damaged zinc coatings arising from fabrication; cure primer fully before shipping to site; include compatible primer for site finishing and correction of surface abrasions to zinc coatings and factory applied primer.

.2 Remove weld slag and splatter from exposed surfaces.

.3 Fill and sand smooth tool marks, abrasions and surface blemishes to present smooth uniform surfaces.

3 Execution

3.1 EXAMINATION

.1 Examine substrates, door swing arcs, areas of installation and conditions affecting installation for compliance with requirements for Manufacturer's installation tolerances and other conditions affecting performance of work of this Section.

.2 Verify roughing-in for embedded and built-in anchor locations before installing frames.

.3 Verify door and frame size, door swing and ratings with door opening number before installing frames.

.4 Installation of hollow metal doors and frames will denote acceptance of site conditions.

3.2 INSTALLATION

.1 Install steel doors, frames, and accessories in accordance with reviewed shop drawings, ANSI A250.11, CSDMA Installation Guide, Manufacturer's data, and as specified in this Section.

.2 Door Frames:

.1 Remove temporary spreaders before installing door frames, leaving exposed surfaces smooth and undamaged.

.2 Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set; limit of acceptable frame distortion 2mm (1/16") out of plumb measured on face of frame, maximum twist corner to corner of 3mm (1/8"); align horizontal lines in final assembly.

.3 Brace frames rigidly in position until adjacent construction is complete; install wooden spreaders at third points of frame rebate to maintain frame width, install centre brace to support head of frames 1mm 4' and wider in accordance with ANSI A250.1; do not use temporary metal spreaders for bracing of frames.

.4 Install studded door silencers.

.5 For frames over 1220mm (4') in width, provide vertical support at the centre of head.
.6 Grout filled frames: Refer to drawings and Section 04 20 00.

.3 Frame Tolerances: Install frames to tolerances listed in ANSI A250.11, and as follows:
.1 Squareness: Maximum 0.8mm (1/32") measured across opening between hinge jam and strike jamb.
.2 Plumbness: Maximum 0.8mm (1/32") measured from bottom of frame to head level.
.3 Alignment: Maximum 0.8mm (1/32") measured offset between face of hinge jamb and strike jamb relative to wall construction.
.4 Twist: Maximum 0.8mm (1/32") measured from leading edge of outside frame rabbet to leading edge of inside frame rabbet.

.4 Doors:
.1 Fit hollow metal doors accurately in frames within clearances required for proper operation; shim as necessary for proper operation.
.2 Install hardware in accordance with Manufacturers' templates and instructions.
.3 Adjust operable parts for correct clearances and function.
.4 Install glazing materials .
.5 Install fire rated doors within clearances specified in NFPA 80.
.6 Install louvers and vents.

.5 Adjusting and Cleaning
.1 Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of air-drying primer compatible with factory applied primer, and as follows:
.1 Clean exposed surfaces with soap and water to remove foreign matter before site touch-up.
.2 Finish exposed site welds to a smooth uniform surface and touch-up with site applied rust inhibitive primer.
.3 Site apply touch-up primer on exposed surfaces where zinc coating or factory applied primer has been damaged during installation or handling.

END OF SECTION

1 General

1.1 SUMMARY

.1 This Section includes requirements for design, supply and installation of glazed curtain wall system consisting of, but not limited to, the following:
- .1 Curtain wall system.
- .2 Connections to structural support systems, fasteners, and accessories required for a complete installation of the glazed aluminum curtain wall system.
- .3 Glass infill panels (spandrels and shadow boxes).
- .4 Gap-filling foamed-place insulation.
- .5 Perimeter sealant.

1.2 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 American Society for Testing and Materials (ASTM):
- .1 ASTM A36/A36M, Specification for Carbon Structural Steel.
- .2 ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .3 ASTM A167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .4 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .5 ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .6 ASTM B22, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .7 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.
- .8 ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls, by Uniform Static Air Pressure Difference.
- .9 ASTM E331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform Static Air Pressure Difference.
- .10 ASTM E413, Classification for Rating Sound Insulation.
- .11 ASTM E1105, Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.

.3 American Architectural Manufacturers Association (AAMA):
- .1 AAMA CW-10, Care and Handling of Architectural Aluminum From Shop to Site.
- .2 AAMA CW-11, Design Wind Loads and Boundary Layer Wind Tunnel Testing.
- .3 AAMA T1R-A1, Sound Control for Fenestration Products.
- .4 AAMA 501, Methods of Test for Exterior Walls.

.5 AAMA 611, Voluntary Specifications for Anodized Finishes Architectural Aluminum.
.6 AAMA 612, Voluntary Specifications, Performance Requirements, and Test Procedures for Combined Coatings of Anode Oxide and Transparent Organic Coatings on Architectural Aluminum.
.7 AAMA 2603, Voluntary Specification Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
.8 AAMA 2604, Voluntary Specification Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.

.4 Canadian Standards Association (CSA):
.1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
.2 CSA S136, North American Specification for the Design of Cold Formed Steel Structural Members.
.3 CAN/CSA-S157/S157.1, Strength Design in Aluminum/Commentary on CAN/CSA-S157, Strength Design in Aluminum.
.4 CSA W59.2, Welded Aluminum Construction.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Co-ordination: co-ordinate work of this Section with installation of flashing placement, vapour retarder placement, components or materials.

.2 Pre-Installation Meetings:
.1 Convene pre-installation meeting 2 week prior to beginning work of this Section.
.2 Require attendance of the Consultant, Installer, Manufacturer, representatives of door systems to be installed in curtain wall system, and other parties directly affected by the work of this Section. Include inspection agency representative.
.3 Review:
.1 Curtain wall system Drawings, Specifications, and other Contract Documents affecting work.
.2 Submittals completed and yet to be completed.
.3 Materials, shop and site fabrication, installation requirements, and structural silicone joints.
.4 Required inspections, operational testing, and certifying procedures.
.5 Construction schedule related to other work affecting curtain wall installation and verification of availability of materials, Installer's personnel, equipment, and facilities required to make progress and avoid delays.
.6 Preparation and installation procedures and coordination and scheduling required with related work.
.7 Weather and forecasted weather conditions and procedures for coping with unfavourable conditions.
.4 Tour, inspect, and discuss conditions, connections to building structure, and other preparatory work performed by other Installers.

.5 Prepare and distribute minutes of meeting to Owner and participating parties.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

.1 Design curtain wall system, including comprehensive engineering and thermal analysis by a qualified Engineer specialized in work of this Section, using structural performance requirements and design criteria indicated herein.

.2 Compartmentalization seals to be air and watertight and capable of supporting design air pressure differences.

.3 Windows in Curtain Wall System: Design curtain wall system to receive aluminum-framed and fixed spandrel panel with insulated back pan.

.4 System Design: Design and size components to withstand dead loads and live loads caused by positive and negative wind loads acting normal to plane of wall as calculated in accordance with applicable code, when tested in accordance with ASTM E330.

.5 Design structural steel used for anchorage in accordance with CA/CSA-S16.1.

.6 Design curtain wall anchors to accommodate thermal, seismic, and building movements without causing detrimental effect to system components and sealants, and to have a minimum expected service life of 30 years in accordance with CSA S478.

.7 Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable code.

.8 Effects of Combinations of Loads: Design system to withstand the most unfavourable combinations of loads.

.9 Deflection: Design structural performance of aluminum components of curtain wall in accordance with CSA S157/S157.1.

.1 Deflection Normal to Wall Plane: Limit mullion deflection to L/175 or 19mm whichever is less for spans less than 4270mm; L/240 + 6mm for spans higher than 4270mm, with full recovery of glazing materials.

.2 Deflection Parallel to Glazing Plane: L/360 of clear span or 3mm, whichever is smaller.

.10 Deflection limits for sheet metal and air vapour barriers shall be L/360 of span or maximum 6mm whichever is less, under design loading.

.11 System Assembly: Accommodate without damage to system, components or deterioration of seals, movement within system, movement between system and perimeter framing components, dynamic loading and release of loads, deflection of structural support framing, tolerance of supporting components, column shortening, long-term creep of structural members, story drift, and deflection from uniformly distributed and concentrated live loads.

.12 Thermal Transmittance (U-factor): Fixed glazing and framing areas utilizing shall have U-factor of not more than 2.15 W/m² x K as determined according to NFRC 100.

.13 Air Infiltration: Limit air infiltration through assembly to 0.00015 m^3/m^2 of wall area, measured at a reference differential pressure across assembly of 300 Pa or 6.24 PFF as measured in accordance with ASTM E283.

.14 Water Leakage:

.1 Design system to provide resistance to water entry as evaluated by the following test procedures:

.1 Static Water Infiltration – No leakage at 720 Pa when tested to ASTM A331 or ASTM 1105.

.2 Dynamic Water Infiltration – No leakage at 720 Pa when testing to AAMA 501.1.

.15 Condensation Resistance: Prevent condensation and frost on inside surfaces of system when subject to outside temperature of minus 25°C and 24 kph wind speed and inside temperature of 21°C when interior relative humidity is 30% in a temperature index of 60 in accordance with CSA-A440.

.16 Expansion / Contraction: System to provide for expansion and contraction within system components caused by a cycling temperature range of 100°C over a 12 hour period without causing detrimental effect to system components.

.17 Surface Temperature: System to be capable of withstanding metal surface temperature range of 110°C without buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance. Design frames so that edges of inner pane of insulating glass units do not fall more than 8°C below the temperature of the centre of the inner pane.

.18 System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.

.1 Inconspicuously locate vents and drain holes to prevent staining, streaking or marking of glass or framing. Size vents to provide instantaneous pressure equalization. Provide baffles to vent openings to prevent direct rainwater entry.

.2 Incorporate vertical and horizontal compartments behind exterior caps and frame-supported structural sealant glazed joints to suit spatial distribution of wind pressures.

.3 Glazing pockets vented and drained to the exteriors.

.4 All exposed end of mullions and caps to be capped and sealed while not compromising drainage quality.

.19 Air and Vapour Seal: Maintain continuous air barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound. Position thermal insulation on exterior surface of air barrier and vapour retarder. Locate air seals to prevent contact between interior humid air and exterior cold air and structure components, and to prevent moisture accumulation on these surfaces during cold weather.

.20 Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

.21 Design glass and glazing in accordance with requirements listed below:
- .1 Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass as calculated in accordance with the Ontario Building Code and to withstand design pressures specified in applicable sections.
- .2 Where glass extends from 1070mm to floor, design lateral loads, in addition to other load requirements, in accordance with applicable codes.
- .3 Unless otherwise specified, limit glass deflection to L/175 or flexure limit of glass with full recovery of glazing materials, whichever is less.

.22 Joint Movement Capability between System and Adjacent Construction: Design expansion joints with movement capability as specified Structural Consultant's specifications or as indicated, but not less than +/- 50% of joint width, without detrimental effects to assembly and adjacent construction.

1.5 SUBMITTALS FOR REVIEW

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

.2 Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details and water flow drainage diagrams.

.3 Shop Drawings:
- .1 Shop drawings shall bear the professional seal and signature of a Professional Engineer licensed to design structures and registered by authority having jurisdiction in the location of the Work.
- .2 Furnish complete shop and erection drawings required for the work of this Section to the Consultant for review prior to fabrication.
- .3 Co-ordinate shop drawings for work of this Section with those for other trades to ensure correct interface details required to provide watertight installation.
- .4 Shop drawings shall incorporate plans, elevations, sections and details for all work in this Section. The details shall show and specify all metal and glass thicknesses, types and finishes, areas to be sealed and sealant materials, gaskets, glazing methods, direction and magnitude of thermal expansion, type of construction including joinery, fasteners and welds, all anchorage assemblies and components, the fabrication and erection tolerances for the work in this Section and the adjoining related work of other Sections.
- .5 Submit structural calculations certified by a Professional Engineer licensed to design structures and registered by authority having jurisdiction in the location of the Work, substantiating sizes for members and connections based on the design loads before commencing fabrication.

.4 Samples:
- .1 Submit duplicate minimum 300mm x 300mm samples of each type of aluminum finish specified.
- .2 Upon Consultant's request furnish samples of glass types, gaskets, tapes and sealants.

1.6 SUBMITTALS FOR INFORMATION

.1 Qualifications Data: For Manufacturer and Installer. Include proof of adequate facilities and capacity to produce work.

.2 Test Reports: Submit substantiating engineering data, test results of previous tests by independent laboratory, which purport to meet performance criteria, and other supportive data. Include reports for insulating glass units and structural silicone sealant in accordance to CGSB 12.8. Test report to be within 5 years from current date.

.3 Submit test reports of the insulating glass units to be supplied as prescribed in CAN/CGSB-12.8 showing successful results. Tests shall be conducted, and reports prepared by an approved, independent testing laboratory. Test report to be within 5 years from current date.

.4 Sealant Manufacturer's Certificates: Certifying that:

- .1 Sealant materials selected for use are from those specified in accordance with ASTM C794.
- .2 Surface preparation and application requirements have been reviewed to suit Project requirements, and instructions given to Installers.
- .3 Sealants are compatible with other materials and products in curtain wall assembly and adjacent construction.

.5 Finish Coating Manufacturer's Details: Submit name, address, phone number, and website address of coating Suppliers and Applicators.

.6 Installation Data: Special installation requirements.

.7 Submit Quality Control Manual outlining quality control procedures and practice encompassing all aspects of curtain wall production and installation.

.8 Submit sealant Manufacturer's sealant compatibility statement that all materials in contact with structural sealants are compatible with the sealants in accordance with ASTM C1087. Submit sealant Manufacturer's statement and test data confirming that sealant stress is less than 138 kPa and a safety factor of 5:1.

.9 Submit glass thermal and wind load stress analysis documenting adequate glass thickness and/or heat treatment to meet stresses generated. Thermal stress analysis to consider effects of external and internal shading, conduction at glass edge, and contribution of low-e coatings.

.10 Submit finish coating manufacturer's data: Name, address, phone number, and web site address of coating Suppliers and Applicators.

.11 Submit results of thermal modeling of all critical and typical cross-sections to assess both overall U value and establish condensation resistance. Results to be submitted in a format acceptable to Consultant.

.12 Professional Structural Engineer's Letters of Assurance:

- .1 Provide letters or completed prescribed forms signed by a Professional Structural Engineer licensed in the Province where the Project is located, certifying that the curtain wall system has been designed, fabricated and installed in accordance with the structural performance requirements of this Section and of the applicable codes, including verification that:
  - .1 Specified products have been used.

.2 Designs and installations as tested, have been installed on the Project.
.3 Loads and movement requirements have been achieved.
.4 Curtain wall framing designed as guards conforms to the applicable code.
.5 Summary of Design and Field review requirements.

.2 The Engineer who sealed the shop drawings shall provide field review of installation and shall provide sufficient reviews in order to provide letters of professional assurance.

1.7 CLOSEOUT SUBMITTALS

.1 Warranty Documentation: Submit Manufacturer warranty and ensure forms have been completed in Owner's name and registered with Manufacturer.

.2 Maintenance Data: For glazed aluminum curtain walls and windows; include instructions for re-glazing and as follows:
.1 Instructions covering re-glazing, adjustments, recommended cleaning procedures and other relevant maintenance data.

1.8 QUALITY ASSURANCE

.1 Perform Work in accordance with AAMA - Aluminum Curtain Wall Design Guide Manual.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 5 years documented local experience, and employing a qualified Building Envelope Consultant experienced in the Province where the Project is located.

.3 Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years' documented experience and approved by Manufacturer.

.4 Glass and glazing work under this Section shall conform to the Insulating Glass Manufacturers Alliance and to the recommendations of the glass and sealed unit Manufacturers.

1.9 STORAGE, DELIVERY, HANDLING AND PROTECTION

.1 Handle work of this Section in accordance with AAMA - Curtain Wall Manual CW-10.

.2 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.3 Assembled units and their component parts shall be transported, handled and stored in a manner to preclude damage of any nature.

.4 Ship and store pre-glazed units in upright position only or use method which will positively prevent extrusion of sealants and shifting of glass within framing.

.5 Accessory materials required for erection at the site shall be delivered to the site in Manufacturer's labelled containers.

.6 Remove all units or components which are cracked, bent, chipped, scratched or otherwise unsuitable for installation and replace with new.

1.10 SITE CONDITIONS

.1 Provide safe and adequate equipment on the site to execute the work of this Section, including scaffolding, staging, hoisting, safety protection equipment, tools, plant and other equipment required for the completion of the work of this Section.

.2 Coordinate and verify, by measurement at the job site, all dimensions affecting the work of this Section. Submit written notifications to the Consultant any field dimensions and conditions which are at variance with those on the reviewed shop drawings. The decision regarding corrective measures shall be obtained from the Consultant prior to the fabrication of the item affected.

1.11 WARRANTY

.1 Provide a 5 year warranty to correct defective Work. Include coverage for complete system against failure to meet specified requirements.

.2 Provide 10 year manufacturer warranty for glazed units as specified in Section 08 80 00.

.3 Provide 10 year manufacturer warranty for metal finishes. Failures shall include excessive fading, non-uniformity of colour, cracking, peeling, delamination and corrosion.

.4 Warranties shall include removing and replacing covering and adjacent components and finishes. Warranty period shall recommence on remedied work.

2 Products

2.1 MATERIALS

.1 Aluminum:
- .1 Extrusions: AA6063-T5 alloy, anodizing quality, conforming to ASTM B221-12.
- .2 Plate and Sheet: AA1100-H14 alloy, anodizing quality unless otherwise indicated minimum 0.125" thick, conforming to ASTM B209, with special hardness for flat aluminum spandrel panels.
- .3 Exposed surfaces of aluminum shall be free of die marks, scratches, blisters, "leave-off" marks, or other blemishes, whether left unfinished or finished.

.2 Structural Steel Sections and Steel Plate:
- .1 CSA-G40.20/G40.21, Grade 260W.

.3 Galvanized Steel Sheet:
- .1 Commercial grade, stretcher levelled, or temper rolled, with galvanized zinc G90 (Z275) coating conforming to ASTM A653/A653M.

.4 Glass: Refer to Section 08 80 00 and as specified in this Section for insulated glass units.

.1 Glass Thickness: Where glass thickness is indicated, it is a minimum. Provide glass in thicknesses as needed to conform to requirements specified.

.5 Insulation Materials:

.1 Mineral Wool Insulation for Curtain Wall: To CAN/ULC-S702 Type 1 or ASTM C612 Type IVA or IVB, mineral rock or slag fibre semi-rigid board, conforming to the following:

.1 Board Density: minimum 64kg/m³.

.2 Minimum Thermal Resistance: RSI of 0.74m².K/W per 25.4mm.

.3 Board Size: 600 x length to suit space.

.4 Board Thickness: As indicated on Drawings.

.5 Facing: Unfaced.

.6 Board Edges: Square.

.7 Flame/Smoke Properties: 0 / 0, in accordance with CAN/ULC-S102.

.8 Acceptable Products:

.1 'Curtain Rock' by Rockwool.

.2 'MinWool Curtainwall 80' by Johns Manville.

.3 'Thermafiber VersaBoard' by Owens Corning.

.2 Spandrel Panel Insulation Fasteners: Adhesive bonded pin and disc type insulation fasteners: 25mm (1") diameter perforated disc base with integral 3mm (1/8") square sharpened pin of moulded polyvinylchloride in lengths to suit insulation thickness.

.1 Insulation Retainers: 25mm x 25mm (1" x 1") galvanized sheet steel, punched to catch on pins.

.2 Adhesive for apply clips: High-strength, resilient adhesive having a drying time of 0 to 30 minutes (rapid initial set), and 24 hours final set. Adhesive shall be compatible with the specified insulation adhesive, insulation and galvanized steel.

.6 Sealants:

.1 Perimeter Sealant and Backing Materials: As specified in Section 07 92 00. Colour to be selected by Consultant.

.2 Sealant Used Within System (Not Used for Glazing): Silicone sealant as recommended by curtain wall manufacturer, and with VOC content less than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

.3 Sealing Tape for Inner Face Metal Panels of Infill Panels: Extruded polyisobutylene, ribbon-shaped, non-drying, non-skinning, non-oxidizing, reinforced, width and thickness to suit application but not less than 6mm wide, designed to provide continuous seal.

.1 Product: 'Tremco 440 Tape' by Tremco, 'Weatherban Sealer' by 3M Canada, or acceptable alternate.

.7 Firestopping: As specified in Section 07 84 00.

.8 Vapour Barrier: Clear polyethylene sheet conforming to CAN/CGSB-51.34, thickness to match existing.

.9 Self-Adhered Air and Vapour barrier Membrane: Refer to Section 07 27 13.

.10 Gap-filling foam Insulation: CAN/ULC-S710.1 single-component or CAN/ULC-S711.1 two- component, low VOC, low expansion bead-applied polyurethane based insulating foam sealant providing an air-tight vapour retardant flexible seal compatible with the air vapour retarder system.

.11 Zinc Rich Paint:
- .1 Ready mixed, zinc rich primer conforming to CAN/CGSB-1.181, 'Sealtight Galvafroid Zinc-Rich Coating' by W.R. Meadows of Canada Limited, or 'Zinc Clad No.7 Organic Zinc Rich Primer' by Sherwin Williams Company of Canada Ltd.

.12 Bituminous Paint:
- .1 Conforms to CAN/CGSB-1.108, Type 2.

.13 Fasteners: '400' Series stainless steel, or '300' Series stainless steel.

.14 Flexible Flashings: Flexible EPDM rubber sheet, minimum .060" (60 mils) thick, by Lexcan Limited, or by Dunlop Construction Products Inc., or by Firestone Building Products Company, or acceptable alternate.

.15 Provide door adapters and other components as required to complete the work of this Section.

2.2 CURTAIN WALL SYSTEM

.1 Subject to conformance with requirements, provide the basis of design curtain wall assemblies manufactured by Alumicor Limited, or acceptable alternate systems from acceptable Manufacturers listed.
- .1 Curtain Wall System in standard fully captured configuration
  - .1 Basis of Design System: “ThermaWall 2600”.
- .2 Other acceptable Manufacturers: The following Manufacturers’ products meeting the Performance Requirements specified.
  - .1 Kawneer North America.
  - .2 Oldcastle Building Envelope.
  - .3 US Aluminum.
  - .4 Northern Façade.

2.3 FABRICATION – GENERAL

.1 Fit and assemble component parts in shop as far as practicable. Work that cannot be permanently shop assembled shall be fitted, assembled, marked and disassembled to assure proper fitting in field. Identify shop assembled components on shop drawings for location and erection at Site.

.2 Aluminum components shall be extruded sections and shapes, unless otherwise specified or shown.

.3 Components required, for which extruded sections are not available shall be accurately formed to profiles indicated. Use minimum 1.62mm (14 gauge) sheet aluminum unless otherwise indicated.

.4 All fastenings and connections shall be concealed unless approved by Consultant.

.5 Joints between horizontal and vertical mullions shall be accurately cut and fitted. Horizontal and vertical mullions shall be in true plane with interior and exterior faces in line.

.6 Mechanically joined sections shall have "hairline" joints.

.7 Reinforce members as required to withstand loads and to maintain deflection within allowable limits.

.8 Internally reinforce framing members where work of other trades is to be fastened thereto.

.9 Fabricate expansion joints between mullion sections with formed extruded aluminum internal sleeve sections, secure to permit joint function and maintain true alignment of sections.

.10 Install air cut-offs in continuous vertical members to prevent stack effect of enclosed air columns.

.11 Framing members shall have internally formed keyed slots to receive and retain preformed gaskets, seals and thermal separators.

.12 Pressure plates shall be designed with integrally formed keyed slots to receive seals and of thickness necessary to provide permanent, uniform, sealing pressures for glazing units, without deformation.

.13 Provide inconspicuous, baffled weep holes to properly drain curtain wall cavities to exterior.

.14 Fabricate system to accommodate and interface with work of other Sections by means of rabbets, interlocks, miscellaneous angles, trim and filler sections as required.

.15 Factory glaze system modules as far as practicable. Effect glazing seal in accordance with wall system and glass Manufacturer's recommendations and so as to meet specified design and performance requirements.

.16 Fabricate extruded or formed aluminum sills to profiles indicated to suit wall condition and minimum 2.4mm (3/32") thick. Provide drip deflectors at sill ends and at abutting vertical surfaces. Open ends of sills shall be fitted with neatly applied closure plates. Anchors shall be designed not to work loose after installation. Unless otherwise detailed provide "flush" slip joint at intermediate sill joints.

.17 Form covers, closures, mouldings and trim integral with, or immediately adjacent to work of this Section to profiles indicated on drawings, and as required for a complete installation.

2.4 FABRICATION – INFILL PANELS

.1 Fabricate in accordance with reviewed shop drawings, and mock-ups.

.2 Outer Face:
- .1 Spandrel back-painted glass (BPG) as specified in Section 08 80 00.

.3 Back up pan:
- .1 Fabricate back-up pans from formed sheet as indicated below and braced as required to resist specified forces with sealed corners:

.1 Unfinished interior:
.1 Galvanized Steel Sheet: 0.76mm thick, Z275 (G90).
.2 Insulation:
.1 Adhesive bond impaling pins to panels at 300mm (12") on center each way for securement of insulation.
.2 Install spandrel panel insulation in back-up pans and held in place by insulation fasteners (impale clips) to form continuous thermal barrier behind spandrel panels.
.3 Insulation Fasteners: Impaling clip of plastic or nylon with washer retainer, to be adhered to surface to receive board insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

2.5 FINISHES

.1 Aluminum Finish:
.1 Baked Enamel, Four Coat: To AAMA 2605, high performance fluoropolymer, thermocured system consisting of specially formulated inhibitive primer, barrier coat, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70% polyvinylidene fluoride resin by weight.
.1 Pre-treat aluminum and apply primer and finish coats in strict accordance with Manufacturer's written instructions.
.2 Protect finish with removable protective film.
.3 Acceptable coatings:
.1 Duranar XL by PPG Canada Inc.
.4 Colour and sheen shall be uniform with no visible variations.
.5 Colour: To match existing window frame.

.2 Touch-Up Primer for Galvanized Steel Surfaces: SSPC Paint 20 zinc rich.

.3 Concealed Steel Items: Galvanized in accordance with ASTM A123 to 610 g/m².

.4 Isolate where necessary to prevent electrolysis due to dissimilar metal-to-metal contact or metal-to-masonry and concrete contact. Use bituminous paint, butyl tape or other approved divorcing material.

3 Execution

3.1 EXAMINATION

.1 Check structural elements and adjoining work of other Sections on which work of this Section is dependent, verify governing dimensions, floor elevations, floor to floor heights, minimum clearances between curtain wall and structural frame. Confirm that conditions are satisfactory before proceeding. Commencement of work of this Section indicates acceptance of surfaces and conditions.

3.2 ERECTION

.1 Erect curtain wall system plumb, level and square, in correct relation to work of other Sections, within a maximum non-cumulative deviation of 1/8" per 12'-0" length of member, and with members accurately fitted and aligned at joints and intersections.

.2 Anchor system to building structure, adjusting as required to meet erection tolerances and secure to prevent movement other than that which is expected due to structural deflection and creep and thermal expansion and contraction.

.3 Provide all devices and components required for erection of system.

.4 Provide flashings, fillers, covers and sealants indicated and as required to render system weathertight and to meet specified performance criteria. Ensure effective seal at laps, end joints and changes of direction.

.5 Provide continuity of thermal and air seal/vapour barriers with adjacent thermal and air seal/vapour barrier systems. Pack spaces between frames and adjacent building elements and where shown with fibrous insulation.

.6 Install glass panels and glazing materials in accordance with Section 08 80 00, to glazing method required to achieve performance requirements.

.7 Seal joints between wall system and adjacent building elements with sealant in strict accordance with requirements of Section 07 92 00.

.8 Use concealed fastenings only.

.9 Touch up steel anchoring components, after installation, with zinc rich paint.

3.3 ERECTION TOLERANCES

.1 Install glazed aluminum curtain wall systems to the following maximum tolerances:

- .1 Plumb: 3mm (1/8") in 3000mm (10') with aggregate total not exceeding 6mm (1/4") in 12.2m (40’).
- .2 Level: 3mm (1/8") in 6m (20') with aggregate total not exceeding 6mm (1/4") in 12.2m (40').
- .3 Alignment: Limit misalignment of two adjoining glass panes abutting in the same plane as follows:
  - .1 Limit offset from true alignment to 1.5mm (1/16") where surfaces meet in-line or are separated by reveal or protruding element up to 12mm (1/2") wide.
  - .2 Limit offset from true alignment to 3mm (1/8") where surfaces are separated by reveal or protruding element from 12mm (1/2") to 25mm (1") wide.
  - .3 Limit offset from true alignment to 6mm (1/4”) where surfaces are separated by reveal or protruding element of 25mm (1") or wider.
- .4 Joint Width: Maintain sealant space between glass and adjacent construction to an average of 5/8", with a variation of no more than +3mm (1/8") and 6mm (1/4").
- .5 Location: Limit variation from plane to 3mm (1/8") in 300mm (12") with aggregate total not exceeding 12mm (1/2") over total length.

3.4 MANUFACTURER'S SITE SERVICES

.1 Curtain wall product Manufacturer to provide field surveillance of the installation of their Products.

.2 Schedule Manufacturer’s review of work procedures at stages listed:

- .1 Product Application: 1 off site review.

.2 Fabrication and Handling: 1 review at authorized installers fabrication facilities.
.3 Installation: 3 site reviews at commencement of Work; 50% completion of Work and upon completion of Work.

.3 Submit Manufacturer's written reports to Consultant describing:
.1 The scope of work requested.
.2 Date, time and location.
.3 Procedures performed.
.4 Observed or detected non-compliances or inconsistencies with Manufacturers' recommended instructions.
.5 Limitations or disclaimers regarding the procedures performed.
.6 Obtain reports within seven days of review and submit immediately to Consultant.

.4 Monitor and report installation procedures and unacceptable conditions.

3.5 SITE QUALITY CONTROL

.1 Professional Structural Engineer Inspections: Engage Professional Structural Engineer experienced in design and installation of this work and licensed in the Province where the Project is located, to perform inspections.
.1 Perform timely and regular inspections.
.2 Verify installation conforms to applicable building code.
.3 Prepare and submit inspection forms required by applicable building code.

.2 Remove and replace nonconforming work and retest as specified at Contractor's cost.

3.6 FINAL CLEANING

.1 Remove protective coatings and coverings from prefinished components; clean structural components and fittings; remove excess sealants and other substances that detract from finished appearance after completion of installation.

.2 At completion of work of this Section, remove all labels from glass and clean inner and outer faces of glass and all exposed metal surfaces at interior and exterior. Replace scratched or broken glass and make good any damaged materials, all in accordance with Section 01 70 00.

.3 Coordinate protective measures required to prevent damage or deterioration of structural glass system from subsequent construction activities.

3.7 PROTECTION OF FINISHED WORK

.1 Protect finished Work from damage.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.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.

1.3 RELATED REQUIREMENTS

.1 Coordinate with Work of other Sections having a direct bearing on Work of this Section.

1.4 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Standards:
- .1 ANSI-A250.4 - Steel Doors and Frames Physical Endurance
- .2 ANSI A156.1 - Butts and Hinges
- .3 ANSI A156.3 - Exit Devices
- .4 ANSI A156.4 - Door Controls - Door Closers
- .5 ANSI A156.5 - Cylinders and Input Devices for Locks
- .6 ANSI A156.5 - Auxiliary Locks and Associated Products
- .7 ANSI A156.6 - Architectural Door Trim
- .8 ANSI A156.7 - Template Hinge Dimensions
- .9 ANSI A156.8 - Door Controls - Overhead Holders
- .10 ANSI A156-10 - Power Operated Pedestrian Doors
- .11 ANSI A156.13 - Mortise Locks and Latches
- .12 ANSI A156.14 - Sliding and Folding Door Hardware
- .13 ANSI A156.15 - Closer Holder Release Devices
- .14 ANSI A156.16 - Auxiliary Hardware
- .15 ANSI A156.18 - Material and Finishes
- .16 ANSI A156.19 - Power Assist and Low Energy Power Operated Doors
- .17 ANSI A156.21 - Thresholds
- .18 ANSI A156.22 - Door Gasketing and Edge Sealing Systems
- .19 ANSI A156.25 - Electrified Locking Devices
- .20 ANSI A156.26 - Continuous Hinges
- .21 ANSI A156.30 - High Security Cylinders
- .22 ANSI A156.31 - Electric Strikes and Frame Mounted Actuators
- .23 ANSI A250.4 - Steel Doors and Frames Physical Endurance
- .24 NFPA 80 - Standard for Fire Doors and Other Opening Protectives

.3 Codes
- .1 NFPA 101 - Life Safety Code
- .2 OBC 2012 - Ontario Building Code
- .3 ANSI A117.1 - Accessible and Usable Buildings and Facilities

1.5 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.

1.6 QUALITY ASSURANCE

.1 Products
- .1 Products specified herein are minimum standard. Approved substitutions are listed. Products proposed as substitutions must be accepted by addenda prior to Bid Closing.

.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.

.3 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.

.4 Hardware Distributors
- .1 The Distributor must have a minimum of 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.

.5 Installers
- .1 Hardware Installers must have a minimum of 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.

.6 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 Sub-Contractor (Site Foreman & Project Manager)

.3 Hardware Supplier (AHC)
.4 Hardware Distributor (AHC & Installer)
.5 Related Sub-Contractors (i.e., Electrical, Security Systems)
.6 Consultant

1.7 SUBMITTALS

.1 Updated Finish Hardware Schedule
.1 Prepare and submit six complete detailed hardware schedules prepared in 216mm x 279mm DHI format.

.2 Product Data
.1 Provide in a three-ring binder six 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 complete sets of hardware templates for related fabricating and installation.

.5 Keying Schedule
.1 Provide three 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 copies of the following information for inclusion in Operation and Maintenance Manuals:
.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:
.1 Five of each installation tool used for locks/passage/privacy, all type of door closers, and all exit devices.

1.8 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 Contractor. 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 Contractor's Site Supervisor.

1.9 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.

1.10 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.

1.11 MAINTENANCE

.1 Maintenance Service

- .1 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.

1.12 EXTENDED WARRANTIES

.1 Provide the following manufacturer's warranties beyond the date of expiration of the Contract warranty:

.1 Hinges - Lifetime
.2 Electrified Hinges – 1 year
.3 Mortise locksets - 7 years
.4 Electrified Locksets – 2 years
.5 Exit Devices - 5 years
.6 Door closers - 10 years
.7 Electric Strikes – 5 years

2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Subject to conformance to requirements provide hardware manufactured by the following:
.1 Dorma Group of Companies.
.2 ASSA-ABLOY Group of Companies.
.3 Allegion Group of companies.

2.2 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 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.

2.3 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.

2.4 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 914mm wide and less: 114mm high hinges; doors greater than 914mm to 1220 mm wide: 127mm high hinges; all standard weight.
.4 Supply standard weight and heavy weight concealed bearing hinges on all doors equipped with door closers; ferrous (steel) material for all interior and/or fire-rated doors and stainless steel for exterior doors as listed in the hardware groups.

2.5 SURFACE/FLUSH 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 ULC listed up to 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 ULC listed for 3-hour fire doors with 13mm diameter bolt tip, 19mm throw. Rod length to be 305mm. Supply dustproof strikes with all flushbolts.
.3 Manual Flush Bolt-Wood Doors
.1 Manual flush bolt for wood doors to be ULC listed for 90 minute fire doors with 19mm throw with a 22mm vertical adjustment. Supply dustproof strikes with all flushbolts.
.4 Automatic Flush Bolts-Metal Doors
.1 Automatic flush bolts for metal doors, fully automatic, ULC listed for 3 hour fire doors, low actuation forces, top bolt has spring tension, non-handed with 19mm throw with a 22mm vertical adjustment. Optional rod length for non-rated openings. Auxiliary fire latch that eliminates the bottom bolt for ULC listed doors. Supply dustproof strikes with all flushbolts.
.5 Automatic Flush Bolts- Wood Doors
.1 Automatic flush bolts for wood doors to be fully automatic ULC listed for 90 minute fire doors, low actuation forces, top bolt has spring tension, non-handed with 19mm throw with a 22mm vertical adjustment. Auxiliary fire latch that eliminates the bottom bolt for ULC listed doors (20 minutes only). Supply dustproof strikes with all flushbolts.

2.6 LOCKSETS, LATCHSETS, DEADLOCKS

.1 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 Grade 1 Cylindrical

.1 ANSI/BHMA-A156.2, Grade 1 extra heavy duty residential, commercial, institutional and industrial applications. Latch bolts to be steel with minimum 13mm throw deadlocking on keyed and exterior functions. 19mm throw anti-friction latchbolt on pairs of fire doors. Provide Manufacturer's standard wrought box strike for each latch or lock, with curved lip extended to protect frame. Lock case to be steel. Locks to incorporate one piece spring cage and spindle. Precision solid brass 6-pin cylinder with nickel silver keys. All levers to be solid with no plastic inserts. Locks and latchsets tested to exceed 3,000,000 cycles.

.3 Grade 1 Mortise

.1 ANSI/BHMA-A156.13, Grade 1 Operational, Grade 1 Security, mortise lock for commercial and institutional buildings. Lock cases to have a high strength steel alloy cylinder retainer with a captured ¼-20 set screw. Lock case to be field reversible without chassis disassembly. Supply locksets with lock cases manufactured from 2.7mm steel with internal components of steel with zinc-dichromate plating for corrosion resistance. Case cover to be secured with four screws for increased rigidity. Locks are to feature a full 19mm throw two-piece stainless steel mechanical anti-friction latchbolt with 25mm throw deadbolt constructed of sintered stainless steel. Deadbolt to remain a minimum of 16mm within lock case when fully extended. All mortise locks are to feature external spring cages. Stop works functions to be by turn unit. Lock cases with stop works on edge of lock case will not be accepted. Spindles to be such that if forced it will twist first, then break (approx. 81.3 N/m of torque).

.4 All Grade 1 and Grade 2 cylindrical lever locksets shall have a free wheeling or clutch mechanism, so the lever moves when in the locked position without retracting the latch bolt.

2.7 EXIT DEVICES

.1 Narrow Style: ANSI/BHMA-A156.3, Grade 1 ULC listed for panic hardware and fire exit hardware. 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. Fits door stiles as narrow as 45mm.

.2 Heavy Duty: ANSI/BHMA-A156.3, Grade 1 ULC 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. 1,000,000 cycle testing independently certified by ETL.

.3 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.

.4 Mullions Non-Rated
- .1 Aluminum mullions complete with mullion stabilizers prepared with strikes for use with all rim devices to provide single door performance and security on double door applications.
- .2 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.

.5 Mullions Rated
- .1 Fire rated ULC approved mullion for up to 3 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.

.6 Exit devices installed on exterior doors must have dead latching bolts to ensure tamper proof security.

2.8 DOOR CLOSERS

.1 Door closers to be Grade 1 ANSI/BMHA A156.4, 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 Medium Duty Mechanical (Interior/Exterior)
- .1 ANSI/BHMA-A156.4, non-sized (1-6) and non-handed cylinder body to have 32mm piston diameter with 16mm single heat-treated shaft. Track closer cylinder body non-sized (2-4) or (1-2). Closers to have stamped main arm and forearm (forged steel main arm and forearm EDA and CUSH type arms). Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

.3 Medium Duty Mechanical (Interior)

.1 ANSI/BHMA-A156.4, non-sized (1-4) and non-handed cylinder body. Track closer cylinder body non-sized (1-3). Closers to have stamped main arm and forearm (forged steel main arm and forearm EDA and CUSH type arms). Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck. Closer to have standard metal cover not to exceed 45mm from face of the door.

.4 Heavy Duty Mechanical (Pull Side Mount)

.1 ANSI/BHMA-A156.4, non-sized (1-5) and handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft and certified to exceed ten million full load operating cycles by a recognized independent testing laboratory. Track closers sized 1, 3 or 4. Closers to have forged steel main arm. Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

.5 Heavy Duty Mechanical (Top Jamb Mount)

.1 ANSI/BHMA-A156.4, non-sized (1-5) and handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft and certified to exceed ten million full load operating cycles by a recognized independent testing laboratory. Track closers sized 1, 3 or 4. Closers to have forged steel main arm. Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

.6 Medium Duty Mechanical (Interior-Pull Side Mount)

.1 ANSI/BHMA-A156.4, sized (1, 2, 3 or 4) and handed cylinder body to have 32mm piston diameter with 16mm single heat-treated shaft. Closers to have forged steel main arms. Optional arms to be interchangeable within the series of closers. Standard plastic cover not to exceed 41mm from face of door.

.7 Heavy Duty Mechanical (Multiple Applications)

.1 ANSI/BHMA-A156.4, non-sized (1-6) and non-handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft and certified to exceed ten million full load operating cycles by a recognized independent testing laboratory with power-adjust speed dial to show spring size power. Track closers non-sized 1-4. Closers to have stamped main arm and forearm (forged steel main arm and forearm EDA and CUSH type arms). Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

.8 Heavy Duty Mechanical (Parallel Arm Mount)

.1 ANSI/BHMA-A156.4, non-sized (1-5) and handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft and

certified to exceed ten million full load operating cycles by a recognized independent testing laboratory. Track closers sized 1, 3, or 4. Closers to have forged steel main arm and forearms. Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

.9 Medium Duty Mechanical (Interior-Push Side Mount)

.1 ANSI/BHMA-A156.4, sized (1, 2, 3 or 4) and handed cylinder body to have 32mm piston diameter with 16mm single heat-treated shaft. Closers to have forged steel main arm and forearms. Optional arms to be interchangeable within the series of closers. Standard plastic cover not to exceed 41mm from face of door.

.10 Heavy Duty Single Point Hold-Open (Pull and Push Side Mount):

.1 ANSI/BHMA-A156.4, non-sized (1-4) and non-handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft with adjustable single-point hold open function controlled by solenoid assembly located in a head frame mounted track. Track arm to have single lever arm with low friction track and roller assembly. Unit to have a momentary on/off switch board assembly for testing door release and also provides over-voltage protection.

.11 Heavy Duty Multi-Point Hold-Open (Pull Side Mount):

.1 ANSI/BHMA-A156.4. Provide closer/holder designed to hold open the door in the open position under normal usage and to release and automatically close the door under fire conditions. Closer will include an integral Electro-magnetic holder mechanism designed for use with ULC listed fire detectors, provided with normally closed switches. Sized (3 or 4) and handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft with multi-point hold open function controlled by solenoid in the cylinder assembly. Track arm to have single lever arm with low friction track and roller assembly with swing free function with no-drift feature. Unit to have a momentary on/off switch board assembly for testing door release and also provides over-voltage protection. Where detailed multi-point closer/holders shall incorporate a hold open bypass feature from 0° up to either 80° or 140°.

.12 Heavy Duty Multi-Point (Push Side Mount):

.1 ANSI/BHMA-A156.4. Provide closer/holder designed to hold open the door in the open position under normal usage and to release and automatically close the door under fire conditions. Closer will include an integral Electro-magnetic holder mechanism designed for use with ULC listed fire detectors, provided with normally closed switches. Sized (3 or 4) and handed cylinder body to have 38mm piston diameter with 17.5mm double heat-treated shaft with multi-point hold open function controlled by solenoid in the cylinder assembly. Unit to be supplied with forged steel main arm. Unit to have a momentary on/off switch board assembly for testing door release and also provides over-voltage protection. Where detailed multi-point closer/holders shall incorporate a hold open bypass feature from 0° up to either 80° or 140°.

2.9 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 counter sunk screw holes. Supply double-sided tape for adhesive-mount.

.3 Kick plates will be minimum 0.127mm thick unless listed otherwise; size to be door width less 35mm for single door, and less 25mm for pairs of doors. Heights as scheduled.

2.10 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 by Division 26 to release the door when signaled.

2.11 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.

2.12 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.

2.13 FINISHES

.1 Finishes are specified as follows:
- .1 As indicated on finish hardware schedule.

2.14 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 Provide temporary construction keying system during construction period. Permanent keys will be furnished to the Owner prior to occupancy. The Owner or Owner's Agent will void the operation of the construction keys.
- .3 Key Material: Provide Manufacturer's standard embossed keys of nickel silver to ensure durability.
- .4 Key Quantity: Furnish keys in the following quantities:
  - .1 Temporary construction keys: 10 each.
  - .2 Grand Master keys per grand master group: 6 each.
  - .3 Master keys per master group: 6 each.
  - .4 Change keys per cylinder or keyed alike group: 4 each.
  - .5 5 Extractor tools each.
- .5 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 a cause to require replacement of all or any part of the cylinders and keys involved as deemed necessary at no additional cost to the Owner.
- .6 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.
- .7 Provide complete cross-index system, place keys on markers and hooks in the cabinet as determined by the finial 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 Exterior High-Security Cylinders
  .1 Interior locks and cylinders shall be furnished in a new master key system.
  .2 Exterior locks and cylinders to be high-security removable core cylinders with level-three side-bit milling to allow integration with existing standard key systems.
  .3 Permanent cylinders to be factory-keyed, combinated in sets or subsets, master keyed or great grand master keyed, as directed by Owner. Permanent keys and cylinders shall be marked with the keyset symbol on all key blanks for identification. Visual key control marks or codes will not include the actual key cuts.

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 Manufacturer's 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 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 manufacturer's 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.

3.3 FIELD QUALITY CONTROL

.1 Hardware distributer to 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 and Consultant demonstration and training 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 has been fully demonstrated to the satisfaction of the Owner, and verified by Consultant.

3.4 ADJUSTING AND CLEANING

.1 Check and make final adjustments to each operating item of hardware on each door to ensure proper operation and function.

.2 All hardware to be left clean and free of disfigurements.

.3 Check all locked doors against approved keying schedule.

3.5 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 manufacturer's warranty.

3.6 HARDWARE TYPES AND MANUFACTURERS

HARDWARE TYPES	MANUFACTURER'S PARTS AND PRODUCTS			FINISH
Manufacturer	**Dormakaba Group**	**Allegion Group**	**Assa Abloy Group**	
Hinge: Standard weight concealed ball bearing hinge, NRP, Stainless Steel	PBB CB51 - 4 1/2" x 4" x NRP	IVES 3CB1 - 4 1/2" x 4" x NRP	McKinney TA314 - 4 1/2" x 4" x NRP	630
Passage Lever Set: Cylindrical passage latchset (ANSI F75)	Dorma QCL130 (Sierra Lever)	Schlage ND10S (Rhodes Lever)	Arrow GL01 Series (Sierra Lever)	626
Storeroom Lock Set: Cylindrical lock set, ANSI F86 Storeroom or closet function	Dorma QCL130 (Sierra Lever)	Schlage ND80PD (Rhodes Lever)	Arrow GL82 Series (Sierra Lever)	626
Privacy Lock Set: Lock set with occupancy indicator ("Occupied" / "Vacant") with thumbturn	Dorma D971 (Sierra Lever)	Schlage L9496 (Standard collection 06 lever)	Sargent with V20 indicator	626
Deadbolt: Deadbolt with thumbturn inside only with no exterior trim	Dorma – D881	Schlage – B680	Sargent - 479	626
Panic Bar Set: Rim exit device with F14 outside trim (latch is released by lever)	Dorma – 9300 YR23	Von Duprin - 98L-BE	Sargent – 8815 (B Lever)	630
Closer: Surface closer with metal cover	Dorma - 8900 Series	LCN - 4041XP Series	Sargent - 351 Series	689
Manufacturer	**K.N. Crowder Mfg. Inc.**	**Pemko**	**National Guard Products**	
Weatherstrip: Perimeter Gasketing with Silicone Strip	W-50S	303_S	9002A	628
Door Sweep: Aluminum with Neoprene	W-13S	315_N	200NSS	628
Manufacturer	**K.N. Crowder Mfg. Inc.**	**Pemko**	**National Guard Products**	
Threshold: Extruded aluminum,1/4" high with thermal break	-	2746x6	8213 with SIA finish (slip resistant)	Mill
Smoke Seal Gasket: Adhesive-backed	W22	S88BL	2525C	Black

silicone bulb, category H.				
Manufacturer	**CBH**	**Standard Metal**	**Assa Abloy Group**	
Push Plate: 127 mm (5") x 508 mm (20") push plate	CBH 923 - 5" x 20" x 3M Tape	Standard Metal K11A - 5" x 20" x 3M Tape	Rockwood RM1010 x 5" x 20"	630
Door Pull: 228.6 mm (9") straight door pull	CBH - 7023-1	Standard Metal - 2009-2	Rockwood - 111A	630
Kick Plate Fire-Rated: 254 mm x 38.1 mm less door width, bevelled edges	-	Standard Metal K10F - SIZE x 3M Tape	Rockwood K1050F x SIZE x SA	630
Kick Plate 152 mm: 152 mm x 38.1 mm less door width, bevelled edges	CBH 903 x SIZE x 3M TAPE	Standard Metal K10A - SIZE x 3M Tape	Rockwood K1050 x SIZE x SA	630
Kick Plate 254 mm: 254 mm x 38.1 mm less door width, bevelled edges	CBH 903 x SIZE x 3M TAPE	Standard Metal K10A - SIZE x 3M Tape	Rockwood K1050 x SIZE x SA	630
Manufacturer	**CBH**	**Allegion Group**	**Assa Abloy Group**	
Wall stop	CBH - CBH 140	IVES - WS406CVX	Rockwood - 406	626

3.7 HARDWARE SCHEDULE

.1 Indicated hardware quantities are for one door only. Provide this quantity for each doors requiring new hardware.

.2 Door handing and fire rating as indicated on Drawings.

.3 Hardware Set Schedule:

	Set #1 (45 min. fire rating)	**Additional Requirements**
3	Hinges	
1	Passage Lever Set	
1	Closer	
1	Smoke Seal Gasket	Along perimeter
1	Kickplate Fire-Rated	
	Set #2 (45 min. fire rating)	**Additional Requirements**
3	Hinges	
1	Storeroom Lock Set	Keyed alike for construction
1	Closer	
1	Smoke Seal Gasket	Along perimeter
1	Kickplate Fire-Rated	
	Set #3	**Additional Requirements**
3	Hinges	
1	Privacy Lock Set	Keyed alike for construction

1	Closer	
1	Kickplate 254mm	
	Set #4	**Additional Requirements**
3	Hinges	
1	Passage Lever Set	
1	Closer	
1	Kickplate 254mm	
	Set #5	**Additional Requirements**
3	Hinges	
1	Push Plate	On Corridor Side
1	Door Pull	On Locker Room Side
1	Closer	
1	Kickplate 254mm	
	Set #6	**Additional Requirements**
3	Hinges	
1	Passage Lever Set	
1	Deadbolt	Keyed alike for construction
1	Closer	
1	Kickplate 152mm	
1	Weatherstripping	On header and jambs
1	Door Sweep	On sill
1	Threshold	
1	Wall Stop	
	Set #7	**Additional Requirements**
3	Hinges	
1	Panic Bar Set	
1	Door Pull	
1	Closer	
1	Kickplate 152mm	

.4 Door Hardware Index:

Door Number	Hardware Set Number
D001	1
D002	2
D101	3
D102	3
D103	3
D104	3
D105	3
D106	3
D107	3

Door Number	Hardware Set Number
D108	3
D109	3
D110	3
D111	2
D113	3
D114	3
D115	4
D118	3
D119	3
D202	2
D203	2
D204	5
D206	3
D207	3
D208	3
D209	3
D210	6
D211	7

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

.2 All references standards specified herein imply the latest edition of the standards.

1.2 SUMMARY

.1 Section includes supply and installation of glass and glazing for Sections referencing this Section for products and installation of:
- .1 Glazing materials.
- .2 Sealed insulating glass units (IGU).

1.3 RELATED REQUIREMENTS

.1 Section 06 10 00
.2 Section 07 92 00
.3 Section 08 11 13
.4 Section 08 44 13

1.4 PERFORMANCE REQUIREMENTS

.1 Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass as calculated in accordance with the Ontario Building Code and to withstand design pressures specified in applicable Sections.

.2 Where glass extends from 1070mm to floor, design lateral loads, in addition to other load requirements, in accordance with applicable codes.

.3 Unless otherwise specified, limit glass deflection to L/175 or flexure limit of glass with full recovery of glazing materials, whichever is less.

.4 Provide tempered, laminated, laminated-heat strengthened and heat-soaked glass and related fittings and hardware in doors, side lites, screens, storefronts, glazed curtain walls, and glazed guard rails accordance with applicable codes and as indicated or scheduled.

.5 Unless otherwise specified or indicated, provide tempered glass where sill of glass is less than 300mm above finished floor.

.6 Unless otherwise specified or indicated, provide laminated-heat strengthened and heat-soaked glass where glass is a guard.

.7 Sealed Insulating Glass Units: Provide units free of the following characteristics:
- .1 Appearance of condensation between panes.
- .2 Obstruction of vision at unit perimeter.
- .3 More than 10% measurable deterioration of thermal transmission or shading coefficient values.
- .4 Chipping, cracking, or breakage of glass panes occurring due to manufacturing defects or under specified service conditions.
- .5 Migration of edge spacer.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:
- .1 Coordinate with other work having a direct bearing on work of this Section.
- .2 Coordinate adequate supports in hollow partitions for large mirrors with Installers of applicable Sections.
- .3 Coordination of the Location of Tempering and Laminated Glass Stamps/Logos: Contractor is required to discuss and coordinate the location of the Tempering and Laminating stamps/ logos with the Consultant at the time of shop drawing submission. This is to be reviewed and approved prior to the ordering of any glass.

1.6 SUBMITTALS FOR REIVEW

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

.2 Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.

.3 Product Data on Glazing Sealant: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colours.

.4 Shop Drawings: For glass indicated to comply with performance requirements.
- .1 Clearly indicate glass types, configurations, thicknesses, translucent finishes, treatments, coatings, gaskets, hardware and accessories.
- .2 Indicate forces applied to connections at structure and analysis data.
- .3 Apply signature and seal by a qualified Professional Structural Engineer licensed in the Province where the Project is located.

.5 Samples:
- .1 Submit two 300 x 300mm samples for each type of glass specified.
- .2 Samples for Colour Selection:
  - .1 Allow for a minimum of three iterations of samples for each type of custom coloured glass to the approval of Consultant.
- .3 Samples for Verification: Submit one sample 300 x 300mm in size, exampling each type of glass following Consultant review.
- .4 Glazing Accessory Samples: Submit samples of each type of glazing accessory. For structural glazing sealants, install 300mm length of sealant between two edges of representative glass samples.

.6 Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated or scheduled.

1.7 SUBMITTALS FOR INFORMATION

.1 Manufacturer's Certificate: Certify that glass products conform to requirements.

.2 Qualifications Data: For Installer. Include proof of adequate facilities and capacity to produce work.

.3 Professional Structural Engineer’s Letters of Assurance:
- .1 Provide letters or completed prescribed forms, signed by the Professional Structural Engineer used to perform inspections and design glass, stating

that the glass indicated conforms to performance requirements and design criteria, and has been fabricated and installed in accordance with applicable code requirements.

1.8 QUALITY ASSURANCE

.1 Perform Work in accordance with Ontario Glass and Metal Association (OGMA) Ontario Glazing Systems Specification Manual, supplemented by GANA (Glass Association of North America) Glazing Manual, and GANA Laminated Glazing Reference Manual, for design and fabrication of glazing and installation methods.

.2 Perform Work in accordance with Insulating Glass Manufacturer's Association of Canada (IGMAC) Glazing Guidelines for Sealed Insulating Glass Units, including requirements for guaranteed service life for manufacture and installation of sealed insulating glass units.

.3 Certify units to Insulating Glass Manufacturers Alliance (IGMA) program to ASTM E2190.

.4 Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: An insulating-glass Manufacturer who is approved and certified by coated-glass Manufacturer.

.5 Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years' continuous documented experience on projects of similar scope and size, approved by the Manufacturer, and a member in good standing of the OGMA.

.6 Labelling:

.1 Label glass, including mirrors, with Manufacturer's labels identifying glass type and thickness.

.2 Safety Glazing: Permanently mark glazing with certification label of the Manufacturer. Label shall indicate Manufacturer's name, type of glass, thickness, and the safety glazing standard with which glass complies.

.3 Insulating Glass Units: Permanently mark spacers, or at least one component lite, of units with appropriate certification label of IGMAC.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Protect glazing materials according to Manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

.2 Minimize storage time of materials at site.

.3 Minimize handling. Install glass as soon as possible after delivery.

.4 Store glass at a constant temperature, vertically, blocked off the floor and in a designated clean, dry and dust-free and corrosive contaminant-free interior storage area with adequate air circulation.

.5 Protect glass from contact with contaminants.

1.10 WARRANTY

.1 Provide a 10 year manufacturer's insulated glass unit warranty to include coverage for:
- .1 Sealed glass units from seal failure, interpane dusting or misting of any nature, and replacement of same.
- .2 Delamination of laminated glass and replacement of same.
- .3 Colour fading of interlayer and replacement of whole glass units.
- .4 Reflective coating on mirrors and replacement of same.

.2 Installation of plastic films on glass shall not diminish coverage of warranties for glass.

2 Products

2.1 MATERIALS – GENERAL

.1 Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses and heat treatment as needed to conform to requirements specified.
- .1 Minimum Glass Thickness for Exterior Lites: As indicated by Design.
- .2 Minimum Glass Thickness for Interior Lites: 6mm.

2.2 GLASS MATERIALS

.1 Clear Annealed Float Glass: CAN/CGSB 12.3 glazing quality or ASTM C1036 Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

.2 Heat Strengthened Float Glass (HS): CAN/CGSB 12.9, Type 2 Heat Strengthened, Class A or ASTM C1048; Type I; Kind HS (heat strengthened); Quality-Q3; Class I (clear) unless otherwise indicated; of condition indicated.

.3 Fully Tempered Float Glass (TPG): CAN/CGSB 12.1, Type 2- Fully Tempered, Class B or ASTM C1048; Type I; Quality-Q3; Kind FT (fully tempered); Class I (clear) unless otherwise indicated; of condition indicated.
- .1 Heat soak tempered float glass to BS EN 14179-1 for exterior insulated glass units.

.4 Back Painted Glass (BPG): CAN/CGSB 12.9 spandrel glass or ASTM C1048, Condition C, Type I, Quality-Q3 heat strengthened or fully tempered clear float glass, elastomeric solvent-free coating non-accessible surface, colour selected by Consultant.
- .1 Fabrication: Apply coating at a thickness of at least 13 mils wet or 5 mils dry. Provide accurate and straight edge deletions of coatings at areas of insulating glass assemblies where coating is applied to surfaces scheduled to be in contact with the primary seal of insulating glass units.
- .2 Product: Opaci-Coat as manufactured by ICD High Performance Coatings.
- .3 Colour: to be selected by Consultant from Manufacturer's full range.

2.3 GLAZING ACCESSORIES

.1 Setting Blocks: Neoprene, EPDM or silicone, 80 to 90 Shore A durometer hardness tested to ASTM D2240, length of 25mm for each square metre of

glazing or minimum 100mm x width of glazing rabbet space minus 1.5mm x height to suit glazing method and pane weight and area. Maximum compression set to ASTM D395 and ASTM C864

.2 Spacers: Neoprene EPDM or silicone, 40 to 60 Shore A durometer hardness tested to ASTM D2240, minimum 75mm long x one half the height of the glazing stop x thickness to suit application. Quantity and location in accordance with IGMAC standards and as recommended by the frame and glass Manufacturer. Provide face shims when gunable materials or non-shimmed tapes are used. Provide anti-walk edge blocks or side shims in dry glazed frames to limit glass lateral movement.

.3 Glazing Tape: Preformed butyl compound, UV resistant, self-adhering, coiled on release paper, service temperature range of -40°C to 50°C, colour as selected by Consultant, minimum 3mm thickness and as follows:
- .1 Glass up to 2540 United Millimetres: 5mm.
- .2 Glass Units over 2540 United Millimetres: 6mm.
- .3 Double Glazed Units: 7mm.

.4 Pre-Shimmed Glazing Tape: Pre-formed butyl tape, UV resistant, self-adhering, integral continuous serrated synthetic rubber shim and release paper, 10 to 15 Shore A durometer hardness, service temperature range of -54°C to 104°C, designed for 25% to 50% compression, colour as selected by Consultant, minimum 3mm thick.

.5 Glazing Wedges and Splines: Precision extruded neoprene or EPDM compound, UV resistant, 55 to 65 Shore A durometer hardness, designed for use with pre-shimmed glazing tape, sized to suit glazing channel retaining slot.

.6 Cleaners, Primers, and Sealers: Types recommended by sealant or gasket Manufacturer.

.7 Structural Silicone Glazing Sealant: Structural sealant as specified in Section 07 92 00.

2.4 SEALED INSULATING GLASS UNITS

.1 Fabricate sealed glass units through the Insulating Glass Manufacturers Association of Canada Certification Program to CAN/CGSB 12.8 or ASTM E2910. Sealed units shall bear IGMAC or IGCC/IGMA Certified Products List number and be properly identified.

.2 Sealant:
- .1 Primary Seal: Polyisobutylene as recommended by glazing Manufacturer to meet performance criteria.
- .2 Secondary Seal: two part silicone or polysulfide as recommended by glazing Manufacturer to meet performance criteria.

.3 Perimeter Seal shall consist of three components; a "Warm Edge" spacer; a primary polyisobutylene seal between spacer and glass sheets, and a secondary two-part silicone or polysulfide perimeter seal.

.4 Gas fill with Argon to Manufacturer's specifications after completion of sealed unit fabrication.

.5 Clear Low-Emissivity (Low E) Coating: Provide low emissivity coating as outlined below complying with ASTM C1376 pyrolytically (magnetic sputter vacuum) coated low-emissivity glass, and] resulting in a stable, uniform, nearly invisible coating:
- .1 Basis of Design: Solarban 70.

.6 Insulated glass unit assemblies (IGU):
- .1 IGU-01:
  - .1 Performance:
    - .1 Minimum Visible Light Transmittance: 50%.
    - .2 Visible Reflectance (out): Maximum 15%.
    - .3 Maximum Solar Heat Gain Coefficient: 0.38.
    - .4 Maximum winter 'U' value (Btu/h•ft²•°F): 0.24.
  - .2 Outer Glass Pane:
    - .1 Tint: Gray.
    - .2 Glass Type: TPG.
    - .3 Thickness: 6mm (1/4").
  - .3 Spacer: 12mm warm edge spacer, black.
  - .4 Inner Glass Pane:
    - .1 Tint: Gray.
    - .2 Glass Type: TPG.
    - .3 Thickness: 6mm (1/4").
    - .4 Coating: Low E on Surface 2.

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.

.2 Wet Method -Sealant / Sealant

.1 Place setting blocks at 1/4 points and install glazing light or unit.

.2 Install removable stops with glazing centred in space by inserting spacer shims both sides at 600mm intervals, 6mm below sight line.

.3 Fill gaps between glazing and stops with sealant to depth of bite on glazing, maximum 10mm below sight line to ensure full contact with glazing and continue air and vapour seal.

.4 Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

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 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.

3.5 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.

3.6 GLAZING SCHEDULES

.1 Refer to Windows Schedules and Screen Schedules on the Drawings for locations and extent of all glazing types specified herein.

3.7 GLAZING SCHEDULE

.1 Exterior Hollow Metal Doors:
- .1 IGU-01, as indicated.

.2 Interior Hollow Metal Doors:
- .1 Single 6mm (1/4”) clear tempered safety glazed light.

.3 Exterior Glazed Curtain Wall Window Spandrel Panel:
- .1 Single 6mm (1/4”) Back-Painted Glass (BPG). Colour: To be selected from Manufacturer’s standard.

END OF SECTION

FINISHES SCHEDULE

1 General

1.1 RELATED DOCUMENTS

.1 Refer to Drawings for location of applied finishes schedule in this Section.

.2 Refer to technical specifications for submittal, quality and installation requirements for each product and finish listed in this schedule of finish.

1.2 SCHEDULE INCLUDES

.1 This schedule includes Basis of Design finish and product selections.

SECTION	CODE	ITEM	DESCRIPTION
06 40 23	PL-1	**Plastic Laminate** Cabinets	**Manufacturer:** Wilsonart **Product:** HPL **Colour:** Beigewood 7850-60 **Finish:** Matte **Wear Layer:** High Wear 107HW
06 61 16	SS-1	**Solid Surfacing**	**Manufacturer:** Corian Solid Surface **Colour:** Designer White
09 30 00	CT-1	**Ceramic Tiles** Wall tile	**Manufacturer:** Centura **Product:** Maiolica, MAIW 628-410 **Colour:** Aqua **Size:** 4” x 10” **Grout (G-1) colour:** To be selected from Manufacturer’s standard range.
09 30 00	CT-2	**Ceramic Tiles** Wall tile	**Manufacturer:** Centura **Product:** Vitra Pro Color **Colour:** Greige RAL 0007500 **Size:** 100mm x 200mm (4” x 8”) **Grout (G-2) colour:** To be selected from Manufacturer’s standard range.
09 51 13	ACT-1	**Acoustic Ceiling Tile**	**Manufacturer:** Armstrong Ceiling **Product:** Ultima High NRC Square Lay-in with Prelude XL 15/16” Suspension System **Texture:** Fine **Finish:** 610mm x 610mm (24” x 24”)
09 65 66	VB-1	**Vinyl Base** Fitness Room	**Manufacturer:** Tarkett **Product:** Johnsonite Traditional Vinyl, Type TV **Colour:** 20 Charcoal WG **Height:** 150mm (6”) **Thickness:** 1/8” **Style:** Toeless

FINISHES SCHEDULE

09 65 66	ASF-1	**Athletic Flooring**	**Manufacturer:** Mondo **Product:** Mondo Sport Impact **Colour:** 011 Medium Grey **Size:** 914mm x 914mm tile **Thickness:** 10mm **Pattern:** Refer to Drawings
09 65 66	ASF-2	**Athletic Flooring**	**Manufacturer:** Mondo **Product:** Mondo Sport Impact **Colour:** 073 Dark Blue **Size:** 914mm x 914mm tile **Thickness:** 10mm **Pattern:** Refer to Drawings
09 67 29	EPX-1	**Epoxy Flooring**	**Manufacturer:** Stonhard **Product:** Stonblend GSI **Colour:** Luna **Cove Base:** With 6” Cove Base
09 67 29	EPX-2	**Epoxy Flooring** Shower Bases	**Manufacturer:** Stonhard **Product:** Stonshield HRI with Stonkote CE4 clear sealer **Colour:** Glacier **Texture:** Standard **Cove Base:** With 6” Cove Base
09 67 29	EPX-3	**Epoxy Flooring**	**Manufacturer:** Stonhard **Product:** Stonkote GS4 **Colour:** Pewter **Texture:** Texture 2 (slip-resistant) **Cove Base:** With 6” Cove Base
09 90 00	PT-1	**Paint**	**Manufacturer:** Sherwin-Williams **Colour:** SW 7008, Alabaster
09 90 00	PT-2	**Paint** Accent Paint in Dorms	**Manufacturer:** Sherwin-Williams **Colour:** SW 6495, Great Falls
09 90 00	PT-3	**Paint** Accent Paint in Fitness Room	**Manufacturer:** Sherwin-Williams **Colour:** SW 7602, Indigo Batik
09 90 00	PT-4	**Paint** Hollow Metal Doors and Frames	**Manufacturer:** Sherwin-Williams **Colour:** SW 9170, Acier
09 90 00	PT-5	**Paint** Exposed Ceiling in Fitness Room	**Manufacturer:** Sherwin-Williams **Colour:** SW 6258, Tricon Black
10 21 33	CHP-1	**Change Room Partition**	**Manufacturer:** Hadrian Inc. **Product:** Solid Phenolic Toilet Partitions **Colour:** 212 Blueberry
12 36 17	SST	**Stainless Steel Countertop, Backsplash and Sink**	Refer to Section 12 36 17

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirement for supply and installation of components required for a complete wall and ceiling assembly with proprietary components as follows:

- .1 Non-Loadbearing Steel Framing:
  - .1 Metal Studs
  - .2 Floor and Ceiling Partition Track
  - .3 Furring Members
  - .4 Shaft wall framing
  - .5 Drywall Grid Suspension for Ceilings
- .2 Gypsum board panels:
  - .1 Gypsum Ceiling Board
  - .2 Cement Board
  - .3 High Impact Resistant Gypsum Board
  - .4 Shaft wall liner panels
- .3 Gypsum Wallboard Accessories
- .4 Access Panels
- .5 Acoustic insulation and accessories

1.3 RELATED REQUIREMENTS

.1 Section 05 40 00
.2 Section 05 50 00
.3 Section 06 10 00
.4 Section 07 84 00
.5 Section 07 92 00
.6 Section 08 11 13
.7 Section 09 90 00

1.4 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Canadian Standards Association (CSA):
- .1 CSA S136, North American Specification for the Design of Cold-Formed Steel Structural Members.

.3 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-7.1, Lightweight Steel Wall Framing Components.

.4 American Society for Testing and Materials International (ASTM):
- .1 ASTM A641/A641M, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.

.2 ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

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

.4 ASTM A875/A875M, Specification for Steel Sheet, Zinc-5% Aluminum Alloy-coated by the Hot Dip Process.

.5 ASTM A1003/A1003M, Specification for Steel Sheet, Carbon, Metallic and Non-Metallic Coated for Cold Formed Framing Members.

.6 ASTM A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.

.7 ASTM A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

.8 ASTM B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

.9 ASTM C11, Standard Terminology Relating to Gypsum and Related Building Materials.

.10 ASTM C473, Standard Test Methods for Physical Testing of Gypsum Panel Products.

.11 ASTM C475/C475M, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.12 ASTM C514, Standard Specifications for Nails for the Application of Gypsum Board.

.13 ASTM C645, Standard Specification for Non-structural Steel Framing Members.

.14 ASTM C665, Standard Specification for Mineral-Fibre Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

.15 ASTM C754, Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

.16 ASTM C834, Standard Specification for Latex Sealants.

.17 ASTM C840, Standard Specification for Application and Finishing of Gypsum Board.

.18 ASTM C841, Standard Specification for Installation of Interior Lathing and Furring.

.19 ASTM C954, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033" to 0.112" in Thickness.

.20 ASTM C955, Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.

.21 ASTM C1002, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.22 ASTM C1047, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

.23 ASTM C1177/C1177M, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

.24 ASTM C1178/C1178M, Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.
.25 ASTM C1186, Standard Specification for Flat Fiber-Cement Sheets.
.26 ASTM C1278/C1278M, Standard Specification for Fiber-Reinforced Gypsum Panel.
.27 ASTM C1325, Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units.
.28 ASTM C1396/C1396M, Standard Specification for Gypsum Board.
.29 ASTM C1629/C1629M, Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
.30 ASTM C1658/C1658M, Standard Specification for Glass Mat Gypsum Panels.
.31 ASTM D3273, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
.32 ASTM D3274, Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation.
.33 ASTM D3678, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Interior-Profile Extrusions.

.5 Gypsum Association (GA):
.1 GA-214, Recommended Levels of Gypsum Board Finish.
.2 GA-216, Application and Finishing of Gypsum Board.
.3 GA-231, Assessing Water Damage to Gypsum Board.
.4 GA-238, Guidelines for the Prevention of Mold Growth on Gypsum Board.

1.5 DESIGN CRITERIA

.1 Provide metal framing in accordance with Section 05 40 00.

.2 Lateral Wind Loading, Typical Partitions: Design and install gypsum board components so that the completed partition will withstand a minimum inward and outward pressure of 240 Pa normal to the plane of the wall.

.3 Loading Wind Criteria, Special Partitions: Design and install gypsum board components so that the completed system will withstand the minimum inward and outward pressure of not less than 480 Pa normal to the plane of the wall. This criterion shall apply to the following areas:
.1 Partitions surrounding stairs.
.2 Partitions surrounding plenum and air shafts.

.4 Deflection Criteria: Limit metal framing systems deflection under load to the following:
.1 Deflection, Support Framing Gypsum Board Partitions. Refer to Section 05 40 00.
.2 Deflection, Support Framing Gypsum Board Ceilings: Gypsum board interior suspended ceilings, and partitions supporting tile, shall be designed for deflection not to exceed L/360 of the distance between supports.
.3 Deflection, Support Framing Shaftwall Systems: Deflection of shaftwall systems shall be limited to L/360 of the span in height.

.5 Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ULC or similar UL listed design assemblies acceptable to authorities having jurisdiction.

.6 STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

.7 Seismic Performance: Suspended ceiling board and grid system shall withstand the effects of earthquake motions as required for this post-disaster building and determined according to applicable code and requirements of authorities having jurisdiction. Have this work designed by a Professional Engineer licensed to design structures and registered in the place of Work.

.8 Design suspended ceiling system for adequate support of electrical fixtures as required by Electrical Safety Authority.

.9 Design Modifications: Make design modifications only as may be necessary to meet performance requirements and coordinate the Work. Variations in details and materials which do not adversely affect appearance, durability or strength shall be submitted to the Consultant for review.

1.6 QUALITY ASSURANCE

.1 Contractor executing work of this Section shall have a minimum of 5 years continuous Canadian experience in successful installation of work of type and quality shown and specified. Submit proof of experience upon Consultant's request.

.2 Perform Work in accordance with ASTM C840, GA-214, GA-216 and GA-600.

.3 Handling Gypsum Board: Comply with GA-801.

1.7 SUBMITTALS

.1 Submit submittals in accordance with the requirements of the General Conditions and Section 01 33 00.

.2 Shop Drawings: Submit shop drawings showing the design, construction and relevant details of furring, enclosures and partitions which require a fire rating.

.3 Product Data: Submit Manufacturer's current technical literature for each component.

.4 Samples: Supply for Consultant's review, if requested, samples of the following:
- .1 Board: Submit sample of each panel product specified, 150mm (6") square.
- .2 Trim: Submit sample of each type of trim specified, 305mm (12") long.
- .3 Texture: Submit sample, 305mm (12”) square of textured coated gypsum board.

.5 Quality Assurance Submittals:
- .1 Design Data, Test Reports: Provide Manufacturer's test reports indicating product compliance with indicated requirements.

.2 Manufacturer's Instructions: Provide Manufacturer's written installation instructions.

.3 Professional Structural Engineer's Letters of Assurance:

.1 Provide letters or completed Owner-prescribed forms signed by the Professional Structural Engineer used to prepare the shop drawings, stating that the suspended ceiling board system has been designed accordance with the structural performance requirements of the applicable codes, including verification that:

.1 Specified products have been used.

.2 Designs and installations as tested, have been installed on the Project.

.3 Loads and movement requirements have been achieved.

1.8 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off the ground, enclosed, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store material in original, undamaged containers or wrappings with Manufacturer's seals and labels intact, in accordance with GA-238 and Manufacturer's recommendations.

.4 Protect bagged products from excessive moisture or wetting. Store metal component sections in crates to prevent damage to material. Do not use bent or deformed material.

1.9 PROJECT CONDITIONS

.1 Establish and maintain environmental conditions for application and finishing gypsum wallboard to comply with ASTM C840 and in accordance with Manufacturer's written instructions.

.2 In cold weather (outdoor temperatures less than 13°C), controlled heat in the range of 13°C to 21°C must be provided. This heat must be maintained both day and night, 24 hours before, during, and after entire gypsum board joint finishing and until the permanent heating system is in operation or the building is occupied. Minimum temperature of 10°C shall be maintained during gypsum board application.

.3 Ventilate building spaces to remove excess moisture and humidity during the drying process. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

2 Products

2.1 MATERIALS - WALLBOARD

.1 Gypsum Ceiling Board Over Non-Humid and Non-Wet Areas:

.1 Sag Resistant Gypsum Board: Meeting requirements of ASTM C1396M, ceiling board manufactured to have more sag resistance than regular type gypsum board with long edges tapered, and as follows:
.1 Location: Ceiling surfaces.
.2 Acceptable Materials:
.1 Sheetrock UltraLight Sag-Resistant Interior Ceiling Board by CGC Inc.
.2 Tough Rock Span 24 Lite-Weight Ceiling Board by Georgia Pacific Canada.
.3 Easi-Lite Lightweight Interior Ceiling Drywall Panel by CertainTeed.

.2 Gypsum Ceiling Board Over Wet Areas:
.1 Conforming to ASTM C1278, 1220mm (48") wide panels of maximum practical lengths to minimize end joints, tapered edges, 13mm (1/2") thick, with water (moisture) and mould resistant core. Mould resistant panel score of 10 when tested in accordance with ASTM D3273 and evaluated to ASTM D3274. Less than 5% water absorption by weight after 2-hour immersion, as per ASTM C473.
.1 Acceptable Materials: Paperless, coated fibreglass mat on face, back and long edges, water-resistant treated core gypsum board, conforming to ASTM C1658:
.1 DensArmour Plus High Performance Interior Panels by, Georgia Pacific Canada.
.2 Fiberock Brand Aqua-Tough AR Interior Panels, by CGC Inc.

.3 Gypsum Ceiling Board Over Humid Areas:
.1 Conforming to ASTM C1178 and C1658 to produce greater resistance to water (moisture) and mould growth, with mould resistant panel score of 10 when tested in accordance with ASTM D3273, paintable paperless glass mat surfaces, and water-resistant treated core gypsum board:
.1 Thickness: 13mm (1/2").
.2 Acceptable Materials:
.1 GlasRoc Tile Backer by CertainTeed Canada.
.2 DensShield Tile Backer by Georgia-Pacific Gypsum LLC.

.4 Cement Board:
.1 Cementitious Backer Board: Reinforced portland cement board, reinforcing mesh embedded near both faces in accordance with ASTM C1325 or ANSI A118.9:
.1 Acceptable Materials:
.1 Durock by CGC Inc.
.2 WonderBoard Lite Backerboard by Custom Building Products.
.3 PermaBASE Cement Board by PermaBASE Building Products, LLC.

.5 High Impact Resistant Gypsum Board:
.1 Manufactured to meet at minimum Surface Abrasion Level 3 of ASTM D4977, Indentation Resistance Level 1 of ASTM D5420, Soft Body Impact Level 3 and Hard Body Impact Level 2 of ASTM C1629. Tapered

edges, minimum 15.9mm (5/8”) thickness, Type X ULC fire rating, conforming to ASTM C1396/ C1396M.

.2 Products and Manufacturers:
- .1 Sheetrock Mold Tough VHI (Very High Impact) Firecode X by CGC Inc.
- .2 Extreme Impact Resistant Drywall with M2Tech Type X by CertainTeed.
- .3 DensArmor Plus Fireguard Impact-Resistant Interior Panels by Georgia Pacific Canada.

.6 Gypsum Board - Shaft liner: ASTM C1396 and ASTM C1658, glass-mat faced, Type X, maximum available size in place; bevelled edges, ends square cut.
- .1 Mould Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- .2 Thickness: 25.4mm.
- .3 Exposure Warranty: Manufacturer’s standard 12-month warranty.
- .4 Product:
  - .1 GlasRoc Shaftliner Type X by CertainTeed Gypsum Canada Inc.,
  - .2 DensGlass Shaftliner by Georgia-Pacific Gypsum LLC,
  - .3 Sheetrock Glass-Mat Liner Panels Mold Tough by CGC Inc.

2.2 MATERIALS - STEEL FRAMING

.1 Non-Loadbearing Steel Framing:
- .1 General:
  - .1 Steel sheet components shall comply with ASTM C645 requirements for metal, unless otherwise indicated.
  - .2 Steel for non-loadbearing members shall have metallic coats that conform to ASTM A653M or ASTM A792M with minimum metallic coating weighs (mass) of Z120 and AZM150 respectively.
  - .3 Framing members shall comply with the CAN/CSA S136 - North American Specification for the Design of Cold Formed Steel Structural Members, for conditions indicated.
- .2 Metal Studs:
  - .1 Minimum 0.0179" (25 gauge), screwable with crimped web and returned flange. Provide knockout openings in web at 150mm (6") O.C. to accommodate (if required) horizontal mechanical and electrical service lines, and bracing. Widths as indicated on Drawings. Provide structural studs where indicated.
  - .2 Framing behind all fire resistant gypsum board shall be minimum 0.0329" (20 gauge).
  - .3 Framing behind all abuse and impact resistant gypsum board, including water (moisture) resistant boards that are also abuse resistant, shall be minimum 0.0329" (20 gauge) base metal thickness.
  - .4 Where metal stud framing forms walls are to be thermally insulated as indicated on Drawings, provide metal studs with integrated fastening system for glass fibre/mineral fibre insulation.
  - .5 Provide special shapes indicated on Drawings as part of steel stud/drywall assemblies.

.3 Studs and Tracks – Shaft Wall Assemblies: ASTM C645; galvanized sheet steel.
  .1 Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated, 0.84mm thick, CH shape unless otherwise indicated.
  .2 Runner Tracks: Manufacturer's standard J-shape track with Manufacturer's standard long-leg length, but at least 51mm long and matching studs in depth, metal thickness matching studs.
  .3 Firestop Tracks: Provide firestop track at head of shaft wall on each floor level.
  .4 Deflection track: Provide steel sheet top track to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and width to accommodate depth of studs.

.4 Floor and Ceiling Partition Track:
  .1 Made from galvanized sheet steel, minimum 0.0179" (25 gauge), with minimum 30mm (1-3/16") legs, top track having longer legs were required to compensate for deflection of structure above. Width to suit metal studs.

.5 Furring Members:
  .1 Hat-shaped, rigid furring channels shall comply with the ASTM C645 and shall have a minimum base steel thickness of (25 gauge) and a minimum depth of 22mm (7/8") the minimum width of furring attachment flanges shall be 13mm (1/2").
  .2 Resilient furring channels designed to reduce sound transmission shall have a minimum base steel thickness of 0.0179" (25 gauge) and have a minimum depth of 13mm (1/2").
  .3 Furring members shall be used for furring out any surface for application of gypsum wallboard finish and for secondary furring member in suspended ceilings/soffits.
  .4 All furring members shall be hot-dipped galvanized.

.6 Drywall Grid Suspension for Ceilings: Conforming to ASTM C645 and ASTM C754, direct hung system composed of main beams and cross furring members that interlock and as follows:
  .1 Tie Wire: Tie wire shall comply with ASTM A641/A641M zinc-coated, soft annealed.
    .1 8 gauge used for hangers in suspended ceiling grid work.
    .2 12 gauge for drywall suspension system.
    .3 18 gauge for wire-tying channels in wall furring and ceiling construction.
  .2 Basis of Design System: USG Drywall Suspension System and Wall-to-Wall Drywall Suspension System Grid Suspension System by USG Ceiling Solutions, or approved alternate by Armstrong World Industries Inc. or Rockfon:
    .1 Commercial quality, cold-rolled steel, hot dipped galvanized to ASTM A635/A635M minimum Z120 (G40) coating designation.
      .1 Main Tees: Fire-rated Heavy Duty classification, 41mm (1.617”) high, integral reversible splice with 38mm (1-1/2”) knurled face.

.1 Cross Tees: Fire rated members with knurled face, 38mm (1-1/2") high x 38mm (1-1/2") wide face.
.2 Wall Moldings: Single web with knurled face, 38mm (1-1/2") x 25mm (1") profile.
.3 Wall Channel: Single web with knurled face, 41mm (1-5/8") x 25mm (1") profile.
.4 Locking Wall Channel: Single web with knurled face, 44mm (1-3/4") x 25mm (1") profile.
.5 Compression Strut: Manufacturer's standard compression strut to accommodate seismic forces.
.6 Accessories: Splice clip, transition clip, wall attachment clip, splice plate and other suspension components required to support ceiling board and other ceiling-supported construction.

2.3 ACOUSTIC MATERIALS

.1 Acoustic Insulation: CAN/ULC-S702 or ASTM C665; preformed glass or mineral fibre, thickness as indicated.
.1 Acoustic Partition Insulation: Friction fit type, unfaced, width to suit stud spacing:
.1 Glass fibre:
.1 'EcoTouch QuietZone PINK FiberGlas Acoustic Insulation' by Owens Corning Canada LP,
.2 'Sound-Shield' by Johns Manville, or
.2 Mineral wool;
.1 'AFB Batts' by Rockwool,
.2 'SAFB' insulation batt by Johns Manville,
.3 'SAFB' by Thermafiber.

.2 Acoustic Sealant: As specified in Section 07 92 00.

.3 Acoustic Putty Pads: Provide non-hardening, permanently resilient, water resistant, acoustic putty. Maintains acoustical ratings per ASTM C919.
.1 Products:
.1 'SealTight' by Kinetics Noise Control Inc.
.2 'QuietPutty 380' manufactured by Serious Materials and distributed by CertainTeed.
.3 'Putty-Pads' by Soundproof Company Inc.

.4 Acoustic Isolation Clips for STC Rated Walls and Ceilings: Purpose made isolation clips consisting of a rubber element into which a standard galvanized steel furring channel is captured without any metal-to-metal or other rigid contact; spaced as required for STC rating and load rating manufactured.
.1 Product:
.1 'GenieClip' by Pliteq Inc.
.2 'Iso-Max Sound Isolation Clips' by Kinetics Noise Control,
.3 or approved alternate.

2.4 SOUND BARRIER MULLION TRIM CAPS

.1 Performance criteria: Meeting minimum STC of 55. Provide for deflection of glazing system and resist internal lateral loading on gypsum wallboard assemblies.

.2 Profile: To match condition at end of gypsum wallboard assembly to existing glazing system mullion in accordance with Manufacturer's recommendations.

.3 Aluminum Extrusions:
- .1 Thickness: 3.2mm (0.125").
- .2 Profile: As approved by Consultant to allow solid attachment and fastening to the partition wall framing.
- .3 Finish: Exposed aluminum finish to be custom to match adjacent existing glazing mullions.

.4 Sound Absorbing Foam:
- .1 Resistant to smoke, flame, and microbial growth.
- .2 Fire Rating: to match partition wall rating.
- .3 Fungi Resistance: Zero rating per ASTM G21.

.5 Compressible Foam: Between edge of extrusion and interior face of glass.
- .1 Thickness: Standard 12.7mm or 25.4mm where required to accommodate a larger mullion deflection.
- .2 Colour: To be selected by Consultant from Manufacturer's standard range.

.6 Acoustical Sound Sealant: Acrylic latex based.

.7 Accessories:
- .1 Provide necessary fasteners and accessories to complete work in accordance with Manufacturer's recommendations.

.8 Products: "Sound Barrier Mullion Trim Cap" by Mull-It-Over Products, or approved alternate.

2.5 ACCESSORIES

.1 Concrete Anchors:
- .1 Self-drilling tie wire anchors, "Red-Head No. T-32" by Phillips Drill Company, Division of ITT Industries of Canada Ltd., or approved equal.

.2 Concrete Inserts:
- .1 Hot-dip galvanized "turtle back" type concrete inserts to suit conditions as approved by Consultant, by Acrow-Richmond National Concrete Accessories, Division of Premetalco Inc., or approved equal.

.3 Gypsum Wallboard Accessories:
- .1 In general, gypsum wallboard accessories shall conform to ASTM C1047.
- .2 Corner Beads:
  - .1 Made from galvanized steel sheet conforming to ASTM A653, minimum 0.455mm (0.0179"). Minimum width of flanges 28mm for 13mm (1-1/8" for 1/2") thick wallboard and 32mm for 16mm (1-1/4" for 5/8") thick wallboard.
- .3 Casing Beads:

.1 Made from galvanized steel sheet conforming to ASTM A653, minimum 30 gauge, U-shaped designed for finishing with joint compound.

.4 Control Joints:

.1 Made from galvanized sheet steel conforming to ASTM A653, minimum 0.455mm (0.0179"), or roll-formed zinc-alloy to resist corrosion, with expansion joint material perforated flanges.

.1 'Zinc Control Joint No. 093' by CGC Inc.

.2 or approved alternate.

.5 Reveals:

.1 Galvanized sheet steel conforming to ASTM A653, minimum 0.455mm (0.0179") in profiles as indicated on Drawings.

.4 Wallboard Screws:

.1 Corrosion resistant, self-drilling, self-tapping gypsum wallboard screws conforming to ASTM C1002 (Type S) and ASTM C954 (Type S-12), 25mm (1") long No. 6 for single layer application, 41mm (1-5/8") long No. 7 for double layer application.

.2 At fire rated construction, type and size of wallboard screw shall be same as used in fire-rating test.

.5 Joint Compound for Interior Gypsum Board:

.1 Conforming to ASTM C475 and as recommended by gypsum wallboard, fire-rated gypsum wallboard and exterior wallboard manufacturers to suit conditions.

.6 Joint Compound for Tile Backing Panels:

.1 Gypsum based tile backing board: Use setting type taping and setting type, sandable topping compounds.

.7 Joint Compound for High Impact Resistant Panels:

.1 ToughRock™ Sandable Joint Compound, by Georgia-Pacific**.**

.2 Durabond/Sheetrock Setting-Type Joint Compound, by CGC Canada Inc.

.3 M2Tech 90 Moisture and Mould Resistant Setting Compound, by CertainTeed.

.8 Resilient Sponge Tape:

.1 Closed cell neoprene sponge type tape with self-sticking adhesive on one side. 'Permastik 122X' by Jacobs and Thompson Ltd., or foamed vinyl type tape, 'Arnofoam' by Arno Adhesive Tape Incorporated.

.9 Adhesive:

.1 Conforming to CGSB 71-GP-25M, and as recommended by Manufacturer and compatible with contacted surfaces.

.10 Bituminous Paint: Acid and alkali resistant bituminous isolation coating.

.11 Butyl Tape: Extruded, High grade macro-polyisobutylene tape of width and shore hardness to suit conditions.

.12 Building Paper: No.15 asphalt saturated, organic felt in accordance with CSA A123.3.

.13 Access Panels:
- .1 Fire Rating: cUL/ULC listed rating equal to fire rated ceiling/wall assembly.
- .2 Frame: 1.6mm thick.
- .3 Door Panel: Minimum 1.9mm thick. Integral attachment flange and drywall bead for flush installation.
- .4 Hinges: Fully concealed pin type, or continuous piano, 175° opening.
- .5 Hardware: Screwdriver slot, quarter turn cam rock for interior locations.
- .6 Sizes: 300mm square for single valves: 400mm square for groups of valves and; 600mm square for body access.
- .7 Styles: Flush panel for gypsum board.
- .8 Manufactured by:
  - .1 Milcor Inc.
  - .2 Nystrom Inc.
  - .3 Bauco Access Solutions Inc.

3 Execution

3.1 EXAMINATION

.1 Examine gypsum wallboard panels for damage and existence of mould. Install only undamaged panels.

.2 Examine gypsum wallboard in accordance with GA-231 for water damage.

.3 Examine areas and substrates, with installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

.4 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

.2 Coordinate installation of gypsum board suspension systems with installation of acoustical ceiling tiles (ACT) suspension systems. Where gypsum board suspension systems abut ACT systems, ensure that ceiling tiles grid fit into gypsum grid without affecting overall design and appearance.

.3 Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION - GENERAL

.1 Conform to ASTM C840, except as otherwise specified herein. Co-operate with mechanical, electrical and other trades to accommodate fixtures, fittings and other items in wallboard areas.

.2 Review extent of temporary heat provided. Carry out the work of this Section only when temperature is maintained and controlled in the range of 13°C to 21°C for at least 24-hours before installing gypsum wallboard and is maintained or can be maintained until joint compound and adhesives are dried or cured.

.3 Metal studs in partitions and bulkheads are to be continuous to underside of steel deck, except where noted otherwise on Drawings. Continue framing around ducts penetrating partitions above ceiling.

.4 Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

.5 Install bracing at terminations in assemblies.

.6 Do not bridge building control and expansion joints with non-loadbearing steel framing members. Frame both sides of joints independently.

.7 Bring gypsum board into contact, but do not force into place.

3.4 STUD PARTITIONS

.1 Install studs in accordance with ASTM C754, GA-216, GA-600, and Manufacturer's written instructions.

.2 Isolate contact surfaces to prevent electrolysis due to metal contact with masonry, concrete or dissimilar metal surfaces. Use bituminous paint, building paper, butyl tape or other approved means.

.3 Provide continuous dampproof course to underside of floor track.

.4 Install studs so flanges within framing system point in same direction.

.5 Provide accurately aligned partition tracks at top and bottom of partitions. Secure at 610mm (24") O.C. and 50mm (2") from each end.

.6 Erect studs vertically in partition tracks at 406mm or 610mm (16" or 24") O.C. maximum as required, and not more than 50mm (2") from abutting walls, openings and each side of corners.

.7 Install cut to length intermediate vertical studs, in same manner and spacing as wall studs, over door frames and above and below other openings.

.8 Door Openings:

- .1 Extend studs on each side of openings from floor to ceiling or structure above, whichever is indicated.
- .2 Install cut to length piece of runner horizontally over door frames.
- .3 Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
- .4 Install two studs at each jamb, unless otherwise indicated.
- .5 Install cripple studs at head adjacent to each jamb stud, with a minimum 13mm (1/2") clearance from jamb stud to allow for installation of control joint in finished assembly.

.9 Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

.10 Fire-Resistance Rated Partitions: Install framing to comply with fire-resistance rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

.11 Where studs extend over 3658mm (12') in height provide internal horizontal bridging spaced approximately 1220mm (4') O.C. vertically and provide double studs at each side of door frames.

.12 Size, brace and reinforce studs as necessary to provide sturdy, rigid partitions to heights and lengths required.

.13 Design bridging to prevent member rotation and member translation perpendicular to the minor axis. Provide for secondary stress affects due to torsion between lines of bridging. Wallboard shall not be used to help restrain member rotation and translation perpendicular to the minor axis. Maximum bridging spacing to be 1220mm (48") O.C.

.14 Securely anchor framing to building structure making allowance for deflection of structure above with relief joint to avoid transmission of structural loads to partitions.

.15 Where horizontal runs of service lines are to be installed, arrange with applicable trades to have lines installed prior to wallboard application.

.16 Install each framing member so fastening surfaces vary not more than 3mm over 305mm (1/8" over 12') from the plane formed by face of adjacent framing.

.17 Ensure close contact of surfaces. Surfaces with depression shall be built up by Contractor, or high points ground down, otherwise effectively caulk the wall perimeter to retard passage of sound waves. Provide acoustic sealant or sponge tape at junction of sound resistant walls and all other walls.

3.5 CEILING FURRING

.1 Install in accordance with ASTM C754, GA-216 and Manufacturer's written instructions.

.2 Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

.3 Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

.4 Hangers:

- .1 Hangers for suspended gypsum wallboard ceiling, bulkheads and duct furring shall support the grillage independent of walls, columns, pipes, ducts, conduit and similar components.
- .2 Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
- .3 Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.

.4 Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
  .1 Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
.5 Wire Hangers: Secure by looping and wire tying, either directly to structure or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
.6 Do not attach hanger to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
.7 Powder actuated fasteners are not approved.
.8 Do not attach hangers to or through steel deck. Attach hangers to steel joists. Where joist spacing is not suitable and where ducts and other equipment interfere, provide adequate cross channels between joists and securely wire tie in position for support of hangers.
.9 Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
.10 Do not connect or suspend steel framing from ducts, pipes, or conduit.
.11 Recessed ceiling fixtures which exert a load in excess of 10lbs/ft² (48.824kg/m^2) shall be suspended independent of ceiling furring for gypsum wallboard application.
.12 Prior to installation of suspension system confirm that ceiling heights called for on room finish schedules and drawings can be maintained and that all recess lighting can be accommodated and shall not interfere with piping, ductwork and the like.
.13 Space hangers at maximum 1220mm (4') O.C. along the runner channels and not more than 150mm (6") from the ends to support weight of ceiling and superimposed loads such as lighting fixtures, diffusers and grilles.
.14 Where ducts are large or where combination of ducts, or combination of ducts and other items interfere so that hanger spacing exceeds 1220mm (4'), increase size of main runner channels and hangers accordingly to sustain increased loading and span.
.15 For fire-resistant rated assemblies, wire tie furring channels to supports.
.16 Install suspension systems that are level to within 3mm (1/8") measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

.5 Carrying Channels:
  .1 Space carrying channels at maximum 1220mm (4') O.C. and not more than 150mm (6") from boundary walls, interruptions of continuity and changes in direction.
  .2 Run channels at right angles to structural framing members where splices are necessary, lap members at least 200mm (8") and wire each end with minimum double strand of tie wire. Avoid clustering or lining up splices.
  .3 Attach channels to rod hangers by bending hanger sharply under bottom of flange of runner and securely wire in place with a saddle tie.

.6 Cross Furring:
- .1 Erect furring channels at right angles to carrying channels.
- .2 Space furring channels at 610mm (24") O.C. and not more than 150mm (6") from boundary walls, interruptions in ceiling continuity and change in direction.
- .3 Secure furring channels to each support with a double strand of tie wire or with clip approved by Manufacturer of furring components. Splice joints by nesting and tying channels together.
- .4 The wallboard furring channels shall be level to a maximum tolerance of 3mm over 3658mm (1/8" over 12') non-cumulative.

3.6 BOARD INSTALLATION – GENERAL

.1 Install gypsum board in accordance with ASTM C840, GA-216 and GA-600, and Manufacturer's instructions.

.2 Vertically, with edges and ends occurring over firm bearing. Erect single layer gypsum board in non-fire rated partitions in most economical direction, with ends and edges occurring over firm bearing.

.3 Erect single layer fire rated gypsum board.

.4 Use screws when fastening gypsum board to metal furring or framing.

.5 Double Layer Applications: Unless otherwise required for fire resistance ratings, install double layer gypsum board as follows:
- .1 Apply gypsum board for first layer, placed perpendicular to framing or furring members. Use fire rated gypsum backing board for fire rated partitions and ceilings.
- .2 Place second layer with fasteners perpendicular to first layer. Offset joints of second layer from joints of first layer.

.6 Place control joints consistent with lines of building spaces as indicated. Where not indicated install as directed at maximum 3.5m spacing. Construct joints using back-to-back casing beads filled with a low modulus sealant capable of flexible joint movement. Maintain fire-resistance rating of wall assemblies.

.7 Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials and as indicated.

.8 Provide types of board material indicated, scheduled and generally as follows:
- .1 Gypsum Ceiling Board Over Wet Areas:
  - .1 Provide over shower areas.
- .2 Gypsum Ceiling Board Over Humid Areas:
  - .1 Provide in Washrooms and Shower Rooms outside of shower area.
- .3 Cement Board:
  - .1 Provide as tile backer for where tile finish is scheduled.
- .4 Gypsum Board - Shaft liner:
  - .1 Provide at shaft wall assembly enclosures.
- .5 High Impact Resistant Gypsum Board:
  - .1 Use high impact resistant gypsum board in all interior areas requiring 16mm (5/8”) thick board (other than those areas identified for cement boards behind shower wall tiles).

.2 Provide minimum base metal thickness studs meeting Manufacturer's requirements to provide the specified properties.

.3 Apply board to framing, with screw fasteners and taped joints in accordance with Manufacturer's instructions.

3.7 SHAFT WALL ASSEMBLIES

.1 General: Install gypsum board shaft wall assemblies to conform to requirements of fire rated assemblies indicated, Manufacturer's written installation instructions, and ASTM C754 other than stud-spacing requirements.

.2 Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

.3 Penetrations: At penetrations in shaft wall, maintain fire rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

.4 Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.

.5 Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

.6 Cant Panels: At projections into shaft exceeding 102mm, install 13 or 16mm thick gypsum board cants covering tops of projections.

.1 Slope cant panels at least 75° from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 610mm o.c. with screws fastened to shaft wall framing.

.2 Where steel framing is required to support gypsum board cants, install framing at 610mm o.c. and extend studs from the projection to shaft wall framing.

3.8 ACOUSTIC ACCESSORIES INSTALLATION

.1 Install resilient furring channels horizontally at maximum 600 on centre. Locate joints over framing members. Install with fasting flange at the bottom.

.2 Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.

.1 Conform to ASTM C919 and with insulation Manufacturer's instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

.3 Install acoustic sealant at gypsum board partition perimeters, in accordance with Section 07 92 00 at:

.1 Metal Framing: Two beads. Alternatively, install two continuous strips of acoustical separation tape.

.2 Face Layer. Seal with 10mm bead.

.3 Seal all penetrations of partitions by conduit, pipe, duct work, rough-in boxes, and cables where Acoustic Sheet Putty Pads are specified and required for Wall Type STC Rating.

.4 Install Acoustic Putty Pads at all penetrations of partitions by conduit, pipe, duct work, rough-in boxes, and cables for partitions with STC ratings of 52 or greater.

3.9 SOUND ISOLATION CLIPS

.1 Install isolation clips to substrate with approved fastener for a minimum pull out and shear of 120lbs.

.2 Wall Installation:
- .1 Install bottom row of clips within 75mm (3") to 150mm (6") from floor.
- .2 Install top row of clips within 150mm (6") from ceiling.
- .3 Install intermediate clips with row spacing not more than 406mm (16") vertically and 1220mm (48") horizontally.
- .4 Add additional clips to secure gypsum board partitions around openings as required.
- .5 Snap furring channel into sound isolation clip and overlap furring channel 150mm (6").
- .6 Secure furring channel to clip with 18 gauge wire or fasteners as recommended by the Manufacturer.
- .7 Secure gypsum board to furring channels as indicated above.

.3 Ceiling Installation:
- .1 Install sound isolation clips a maximum 48” on center. (horizontal)
- .2 Spacing between the furring channels (hat channel) shall not exceed 16”. Install furring channels perpendicular to the joists.
- .3 Fasten the sound isolation clips to the substrate with a fastener approved for a minimum pull out and shear of 120lbs.
- .4 Locate the first row of furring channel within 3 to 6” of the wall edge and install in a checker pattern.
- .5 Furring channel shall not be cantilevered more than 6” beyond the last sound control clip.
- .6 Snap furring channel into sound isolation clip and make joins between clips with a 6” overlap. Secure with 18 ga. wire or framing screws.
- .7 Stagger seams of gypsum board in double layer applications.
- .8 Caulk around entire perimeter of gypsum board, filling the space with non hardening acoustic caulk. Use fire and smoke rated caulking sealant where required. Do not install caulking so that it is ‘proud’ of the gypsum board surface.

3.10 FIRE RESISTANT ASSEMBLIES

.1 Fire resistance rating of gypsum board assemblies and framing shall be as called for on Drawings or schedules, and as required to conform with applicable codes and requirements of authorities having jurisdiction.

.2 Appropriate ULC designs as listed in current ULC list of equipment and materials, Volume II, Building Construction, shall be placed when applicable. Extend partitions full height through ceiling space unless otherwise noted on Drawings.

.3 Vertical bulkheads in ceiling spaces over fire rated glazed partitions, doors and the like shall have same fire rating as the door or partition over which they occur. All such bulkheads shall be of drywall construction unless otherwise noted.

.4 Use fire rated gypsum board as specified.

.5 Where lighting fixtures, diffusers, and the like are recessed into fire rated ceilings or bulkheads, provide enclosure to maintain required fire rating. Form removable panel to give access to fixture outlet box.

.6 Where fire hose cabinets or other fixtures or equipment are recessed in fire rated walls or partitions, provide drywall enclosure or backing to maintain required fire rating, unless otherwise detailed.

3.11 CONTROL JOINTS

.1 Install control joints using metal control joint strip as specified where:
- .1 A partition, furring or column fireproofing abuts a structural element, dissimilar wall or partition assembly, or other vertical penetration, or ceiling.
- .2 A ceiling or soffit abuts a structural element, dissimilar wall or partition assembly or other vertical penetrations.
- .3 Wings of "L", "U" and "T"-shaped ceiling/soffit areas are joined.
- .4 Construction changes within the plane of the partition or ceiling or soffit.
- .5 Partition, restrained ceiling or furring run exceeds 9144mm (30').
- .6 Unrestrained ceiling dimensions exceed 15240mm (50') in either direction.
- .7 Expansion or control joints occur in the base exterior wall.
- .8 Wallboard is installed over masonry control joints.
- .9 And elsewhere as indicated on the Drawings.

.2 Install in accordance with Manufacturer's instructions. Where application is on furring members and double furring members at control joints, place one furring member on each side of the control joint.

3.12 BULKHEADS

.1 Fur out bulkheads in areas indicated and as required to conceal mechanical, electrical or other services in rooms where drywall finishes are scheduled, and elsewhere if called for on Drawings.

.2 Ensure hangers are installed as to prevent splaying.

3.13 ACCESS DOORS

.1 Access doors supplied by this Section and Divisions 20 and 26 shall be built-in by this Section where required in gypsum wallboard installations, in accordance with Manufacturer's recommendations, to match and blend with surrounding surfaces. Refer to Drawings for locations.

3.14 THERMAL BREAK

.1 Install self-sticking resilient sponge tape at edges of wallboard in contact with metal windows or exterior door frames to provide a thermal break. Adhere tape to casing bead and compress during installation.

3.15 SOUND BARRIER MULLION TRIM CAP

.1 Examination:
- .1 Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- .2 Examine walls and adjacent curtain wall for suitable conditions where sound barrier wall end cap will be installed.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.

.2 Installation:
- .1 Measure and cut sound barrier wall end cap to proper lengths.
- .2 Notch around horizontal mullions, sills, or other obstructions leaving appropriate gap for differential movement between the sound barrier wall end cap and the obstruction.
- .3 Apply continuous bead of acoustical sealant to the acoustical foam surface that will be in contact with the drywall edge.
- .4 Place sound barrier wall end cap on the vertical surface of the drywall partition wall and loosely install fasteners in the top and bottom slotted holes of the wall end cap.
- .5 Plumb the wall end cap leaving recommended gap spacing between the interior glass surface and the wall end cap. Foam gasket to be in contact with glass.
- .6 Tighten top and bottom fasteners to secure end cap.
- .7 Install additional fasteners at 300mm on center, minimum.
- .8 Install snap cover to conceal fasteners.
- .9 Apply sealant at joints of dissimilar materials as directed by Consultant.

3.16 FINISHING

.1 Before proceeding with installation of finishing materials ensure the following:
- .1 Wallboard is fastened and held close to framing and furring.
- .2 Fastening heads in wallboard are slightingly below surface in dimple formed by driving tool.

.2 Levels of Gypsum Wallboard Finish:
- .1 Level 0: Temporary construction only.
- .2 Level 1: Plenum areas and above ceilings. Where a fire-resistance rating is required, finishing should be in accordance with reports of fire tests of assemblies that have met the requirements of the fire rating imposed.
- .3 Level 2: Areas of water resistant gypsum backing board under tile, exposed areas where appearance is not critical.
- .4 Level 3: Service corridors and areas to receive heavy or medium textured coatings or heavy-duty wall coverings.

.5 Level 4: Areas to receive light textured coatings or lightweight wall coverings.

.6 Level 5: Areas to receive gloss, semi-gloss or flat sheen paints and critical lighting conditions. Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat over entire surface for corridors, long hallways, walls and ceilings longer than 7500mm or walls higher than 3600mm , and for all curved or angled wall surfaces.

.3 Finish gypsum wallboard in strict accordance with ASTM C840, GA-214 and GA-216 and as follows:

.1 Fill and tape joints and internal corners and fill screw depressions in board face and smooth out along corner beads and metal strip with joint compound.

.2 Mix joint compound (powder) in accordance with Manufacturer's written instructions.

.3 Prefill "V" grooves of rounded edges with special setting type joint compound using a 127mm to 150mm (5" to 6") joint finishing knife. Finish flush with tapered surface ready for tape reinforcing application. Allow prefill material to dry thoroughly before application of embedding compound and tape.

.4 Apply joint compound in thin uniform layer. Embed reinforcing tape accurately centred on joint and securely pressed in, leaving sufficient compound under tape to provide proper bond. Immediately apply skim coat over tape application. Allow to dry thoroughly before application of next coat.

.5 Apply fill coat finishing the tapered depression flush with board surfaces. Allow to dry thoroughly before application of finish coat.

.6 Apply finish coat extending slightly beyond the filler coat and feathered out onto the board surface. Do not apply finish coat to gypsum board scheduled to be sprayed with acoustic surfacing finish.

.7 Sand between coats and following the finishing coat, where necessary, and leave surface smooth and ready for painting.

.8 Finish screw depressions with filler material and finish coat as specified above.

.9 Joint and depression finish shall in no case protrude beyond the plane of the board surface.

.10 Furnish corner beads and metal trim flush with board surface using filler and finishing coats feathered out approximately 50mm (2") and 100mm (4") respectively onto the board surface.

.11 Provide metal casing beads at exposed edges, at junctions of gypsum/cement board with dissimilar material, at control joints and at junction with columns. Casing beads are required at perimeter of gypsum/cement wallboard ceilings and soffits. Fasten with screws at 305mm (12") O.C. along entire length.

.12 Finish gypsum board to receive a Level 4 finish.

3.17 REPAIRS

.1 After taping and finishing has completed, and before decoration, repair all damaged and defective work, including non-decorated surfaces.

.2 Patch holes or openings 13mm (1/2") or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.

.3 Repair holes or openings over 13mm (1/2"), or equivalent size, with 16mm (5/8") thick gypsum wallboard secured in such a manner as to provide solid substrate equivalent to undamaged surface.

.4 Tape and refinish scratched, abraded or damaged finished surfaces including cracks and joints in non-decorated surface to provide smoke tight construction, fire protection equivalent to the fire rated construction and STC equivalent to the sound rated construction.

3.18 PROTECTION

.1 Protect installed products from damage during remainder of construction period.

.2 Remove and replace panels that are damaged.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 The work in this section includes supply and installation for the following:

.2 Tiling and bonding systems for floor and wall tile including:
- .1 Ceramic (CT)

.3 Waterproof membrane

.4 Crack isolation membrane

.5 Tile bonding accessories

.6 Site quality control

1.3 RELATED REQUIREMENTS

.1 Section 07 92 00
.2 Section 09 21 16
.3 Section 09 90 00

1.4 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 American National Standards Institute/Ceramic Tile Institute (ANSI/CTI):
- .1 ANSI/CTI A108.1, Specification for the Installation of Ceramic Tile: Collection of 20 ANSI/CTI A108, A118 and A136 Series of Standards on Tile Installation

.3 American Society for Testing and Materials (ASTM):
- .1 ASTM C241/C241M, Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic
- .2 ASTM C615/C615M, Standard Specification for Granite Dimension Stone
- .3 ASTM C627, Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester
- .4 ASTM C920, Standard Specification for Elastomeric Joint Sealants
- .5 ASTM C1028, Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
- .6 ASTM C1178/C1178M, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel

.4 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-75.1, Tile, Ceramic

.5 Terrazzo, Tile and Marble Association of Canada (TTMAC):
- .1 2019-2021 Specifications Guide 09 30 00, Tile Installation Manual
- .2 Hard Surface Maintenance Guide

1.5 PERFORMANCE REQUIREMENTS

.1 Tile products manufactured and tested to ISO 10545 Series and ANSI A137.1.

.2 Installation Tolerances:
- .1 Variation in Line: For positions shown in plan and continuous lines, do not exceed 1:1000 or 10mm, whichever is less.
- .2 Variation in Plumb: Vertical lines, external corners and other vertical conspicuous lines.
  - .1 Up to 12m in height: Do not exceed 1:1000.
  - .2 More than 12m in height: Do not exceed 9mm.
- .3 Variation in Level: Horizontal bands, horizontal grooves, and other horizontal conspicuous lines, do not exceed 1:1000 or 9mm, whichever is less.
- .4 Variation in Unit Joint Width: Do not exceed 0.8mm.
- .5 Variation in Plane Between Adjacent Units (Lipping or Step-in-Face): Do not exceed 0.8mm difference between planes of adjacent units.
- .6 Jog in Alignment of Edge of Adjacent Units: Do not exceed 0.8mm.

1.6 PRE-INSTALLATION CONFERENCE

.1 Contractor shall hold pre-installation conference 2 weeks prior to commencing work of this Section. Conference shall be attended by the Contractor, Owner, Consultant, concrete finishing Sub-Contractor, tile Installers and tile Manufacturer's representative, setting bed and grout Manufacturer's representative to discuss the following, but not limited to the following:
- .1 Substrate conditions, non-structural cracks, structural cracks and preparation requirements.
- .2 Wall surface irregularities and levelness tolerances, including all remedial requirements.
- .3 Installation of tiles and grouting.
- .4 Edge details and treatments.
- .5 Installation of tile and grout sealers.

.2 Contractor shall ensure that Manufacturer's representatives issues written installation instructions at the pre-installation conference, to all parties attending the pre-installation conference and the Consultant, for all tile types, setting beds, grouts and sealers required for the work of this Section.

.3 Contractor shall within 72 hours of the pre-installation conference, prepare minutes of the conference, and issue minutes to all parties attending the pre-installation conference and the Consultant. Contractor shall clearly indicate required actions and by which party.

1.7 SUBMITTALS FOR REVIEW

.1 Submit submittals in accordance with the General Conditions and Section 01 33 00.

.2 Product Data: For each product. Include installation instructions for using setting materials and grouts.

.3 Shop Drawings: Plans indicating details of special fittings, expansion joints, control joints, and joint layout, graining orientation of tile, and pattern.

.4 Samples:
.1 Submit sample panel of each type and colour tile, 610mm x 610mm (24" x 24"). Adhere to a rigid board with setting compound, grout and a dummy control joint showing sealant as specified. Identify samples by project number, date, name of Sub-Contractor and tile type. Tile and grout used in the building shall correspond to appearance of approved samples in all respects. Do not install tile until samples are approved.
.2 Upon Consultant's request submit samples of base, trim and fittings.

1.8 SUBMITTALS FOR INFORMATION

.1 Installation Data: Manufacturer's special installation requirements.

.2 Tile setting material Manufacturer's review report.

.3 Field test reports.

1.9 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

1.10 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Stock Materials: Provide a minimum 3% of total of each type and of each colour of floor tile and trim used from same production run for project maintenance upon completion. Neatly package and identify materials and deliver to location specified by Owner.

1.11 QUALITY ASSURANCE

.1 Perform work in accordance with TTMAC Specification Guide, Tile Installation Manual.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 3 years documented experience.

.3 Installer Qualifications: Company specializing in performing the work of this Section with minimum 3 years documented experience.

.4 Tile Setting Material Manufacturer's Review:
.1 Prior submitting Submittals obtain tile setting Manufacturer’s review and approval for conformance of tile installation methods and procedures with warranty requirements.
.2 Prepare and submit report signed by the tile setting Manufacturer.
.3 Review of waterproofing membrane installation and provide required testing ensuring waterproofing membrane Manufactures recommended thickness is achieved.

1.12 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store material in original, undamaged containers or wrappings with Manufacturer's seals and labels intact.

.4 Restrict traffic by other trades during installation.

.5 Provide adequate protection of completed tiled surfaces to prevent damage by other trades until final completion of this project. Minimum protection shall consist of 4 mil polyethylene sheets lapped 4" and taped.

1.13 SITE CONDITIONS

.1 Ambient Conditions: Apply tile after completion of work by other Sections is complete; to surfaces sufficiently dry, clean, firm, level, plumb and free from oil or wax or any other material deleterious to tile adhesion and as follows:

.1 Temperature: Maintain tile materials and substrate temperature between TTMAC recommended minimum and maximum temperature range; unless indicated otherwise by manufacturer, for 48 hours before and during installation until materials are fully set and cured; provide additional heat during winter months or at any other time when there is a risk that surface temperatures may drop below minimum recommended temperatures.

.2 Ventilation: Maintain adequate ventilation where Work of this Section generates toxic gases or where there is a risk of raising relative humidity to levels that could damage building finishes and assemblies.

1.14 WARRANTY

.1 Warrant the work of this Section against defects in materials and workmanship in accordance with the General Conditions, but for a period of 5 years from start date in accordance with Section 01 78 36 and agree to promptly make good defects which become evident during the warranty period without cost to the Owner. Defects shall include but not be limited to the following: Cracking, crazing, discolouration, staining, pitting, splitting and deformation of tiles and grout.

2 Products

2.1 MATERIALS – CERAMIC TILE (CT)

.1 Provide Material Meeting ANSI A137.1, and ISO 13006.

.2 Provide coved tile bases, nosings, moulded trimmers for external and internal angles and projections as shown in Drawings.

.3 Refer to Schedule of Finishes for type, product, size, colour and finish textures.

2.2 MORTAR AND GROUT MATERIALS – GENERAL

.1 Acceptable Tile Setting Materials: Subject to conformance to requirements, mortar and grout materials listed below shall be of a uniform quality for each

adhesive, and grout component from a single Manufacturer and each aggregate from one source or producer as follows:
.1 Laticrete International Inc.,
.2 Mapei Corporation,
.3 TEC Incorporated Building Products Group, an H.B. Fuller Company,
.4 Flextile Ltd.

.2 Setting and Grouting Materials: Conform to material standards in ANSI's Specifications for the Installation of that apply to materials and methods specified.
.1 Grout Colours: Refer to Section 09 06 00.

.3 Source limitations: All materials shall be from one manufacturer, forming a complete system.

.4 Products: Provide like products from same production run. Install products in sequence from sequentially numbered dye lots.

2.3 MORTAR AND GROUT SETTING SYSTEMS

.1 Walls with Glass-Mat, Water-Resistant Backing Board (Cement Board Tile Backing Panels) on Metal Stud Wall Framing: TTMAC Detail 305W-2019-2021-B.

.2 Materials General: to ANSI A108/A118/A136.1 and TTMAC Detail indicated:
.1 Thinset Mortar:
.1 4237 latex additive and 211 Crete filler powder by Laticrete,
.2 Kerabond with Keralastic by Mapei,
.3 TEC TA 382 Ultimate LFT by HB Fuller,
.4 '51 Premium Wall & Floor Thin-Set Mortar with 44 Acrylic Additive' by Flextile.
.2 Trowelable Underlayment and screed Compound:
.1 226/3701 mortar mix by Laticrete,
.2 Topcem by Mapei, or
.3 TA 305 Fast Set Deep Patch by TEC, HB Fuller.
.4 FAST-SET SCREED BY Flextile
.3 Grout: ANSI A108/A118/A136.1:
.1 Standard for dry locations:
.1 SPECTRALOCK PRO Premium Grout by Laticrete, or
.2 Mapei UltracolorPlus, or
.3 TEC PowerGrout by HB Fuller or
.4 1600 RSG by Flextile

2.4 TILE SETTING SYSTEMS FOR WET AREAS

.1 Showers and shower change room area to comply with: TTMAC Detail 317-SP-2019-2021.

.2 Materials General: to ANSI A108/A118/A136.1 and TTMAC Detail indicated:
.1 Scratch/Skim/ Bond Coat:
.1 211/4237 by Laticrete,
.2 Kerabond mixed with Keralastic additive by Mapei,
.3 TA392/393 SUPERFLEX ULTRA PREMIUM THIN SET by TEC

.4 #51 FLOOR & WALL PREMIUM MORTAR MIXED #44 ACRYLIC ADDITIVE by Flextile

.2 Mortar Bed/levelling coat: For bed thicknesses over 40mm, suspend reinforcing mesh within mortar bed.
- .1 226/3701 mortar mix by Laticrete,
- .2 Topcem with Planicrete AC by Mapei,
- .3 TA305 FAST SET DEEP PATCH WITH PATCH ADDITIVE by TEC,
- .4 FAST-SET SCREED or 4:1 DRY PACK with #44 Acrylic Additive by Flextile

.3 Waterproof Membrane: ANSI A118.10
- .1 Hydroban by Laticrete
- .2 Aquadefense by Mapei
- .3 TA 316 Hydraflex by TEC, HB Fuller
- .4 WP-900 HYDRO-BLOCK by Flextile

.4 Grout: ANSI A108/A118/A136.1 Epoxy Grout:
- .1 SPECTRALOCK PRO Premium Grout by Laticrete
- .2 Kerapoxy by Mapei
- .3 AccuColour EFX by TEC, HB Fuller
- .4 FLEX-EPOXY 100 GROUT by Flextile

.5 Fibreglass reinforcing mesh and cleavage membrane, as recommended by Manufacture.

2.5 ACCESSORIES

.1 Water: Fresh, clean, potable, free from deleterious matter, acids or alkalis.

.2 Sealant: movement and joint sealants as specified in Section 07 92 00.

.3 Tile Backer Board: As Specified in Section 09 21 16.

.4 Provide fillers, primers, reinforcing fabric and all other materials and accessories as recommended by the crack suppression membrane Manufacturer.

.5 Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout Manufacturers and as follows:
- .1 Job Site Cleaner: Phosphoric acid/nitric acid based cleaning solution mixed in accordance with cleaner Manufacturer’s recommendations and as recommended by tile Manufacturer.
- .2 Maintenance Cleaner: Non-toxic, electrolytic, biodegradable, non-ammonia containing, pH controlled cleaning solution mixed in accordance with Manufacturer’s recommendations.

2.6 MORTAR AND GROUT MIXING

.1 Mix mortars and grouts to comply with referenced standards and mortar and grout Manufacturers' written instructions.

.2 Add materials, water, and additives in accurate proportions.

.3 Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform

quality with optimum performance characteristics for installations indicated or specified.

3 Execution

3.1 EXAMINATION

.1 Verify existing conditions before starting work.

.2 Verify that surfaces are ready to receive work.

.1 Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated or specified.

.2 Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.

.3 Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Consultant.

.3 Verify sealants and grout are cured for manufactured recommended periods at required temperatures and relative humidity conditions, before water immersion.

3.2 PREPARATION

.1 Surface Preparation:

.1 Make backing surfaces level and true to a tolerance in plane of ± 3mm in 2m (1/8” in 8’) for walls and ± 3mm in 3mm (1/8” in 10’) for floors using levelling bed mortar.

.2 Surfaces shall be structurally sound, well fastened, clean and free from dust, oil, grease, paint, tar, wax, curing agents, primers, sealers, form release agents or any deleterious substances that may act as bond barriers.

.3 Backing surfaces shall be dry and fully cured. Dampness must not exceed 5% by volume.

.2 Work of other trades that are required before new tile installation (i.e., electrical conduit installed below ceramic tile) shall be installed, complete and approved before tile installation.

.3 Fill cracks, holes, and depressions in concrete substrates for tiling installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material Manufacturer.

.4 Check as per ASTM F710 for Concrete Preparation for excessive moisture levels & pH of the slab.

3.3 INSTALLATION - GENERAL

.1 Installation of the tile shall be by thin-set method, as indicated on the Drawings and as specified herein;

.1 Install wall tile to gypsum wallboard and moisture resistant wallboard in dry areas using latex modified thin-set setting bed and latex modified wall grout in strict accordance with tile Manufacturers written installation instructions as per the pre-installation conference.

.2 Install mortar bed, tile, and grout to referenced TTMAC Manual and TTMAC systems listed.

.3 Thoroughly clean surfaces to which tile is to be applied.

.4 Back butter all floor tile.

.5 Neatly cut tile around fitments, fixtures, access panels, and the like. Splitting of tile is expressly prohibited except where no alternative is possible. Form intersections, corners and returns accurately.

.6 Finish surfaces flat and level or, sloped and graded as required.

.7 Joint Widths: Install tile with the following joint widths, unless indicated on Drawings:
.1 Ceramic Mosaic Tile: 2mm (1/16”).
.2 Wall Tile: 2mm (1/16”).
.3 Make joints consistent width and alignment within tile area.
.4 Maintain 2/3 of grout joint depth free of setting material.

.8 Joints shall be watertight without voids, cracks or excess grout.

.9 Lay out tile so that fields or patterns are centred on wall areas or architectural features and so that no tile less than 1/2 size occurs.

.10 Arrange and set recessed accessories in tile work so that they are evenly spaced, centred with joints and set true with correct projection. Rigidly install accessories.

.11 Provide Manufacturer's standard trim pieces at changes of direction and at terminations. Unless otherwise indicated provide the following corner and edge conditions:
.1 Internal horizontal corners: Coved.
.2 External vertical and horizontal corners: Bullnosed.
.3 Internal vertical corners and unexposed edges: Square.

.12 Install tiles in patterns and locations as indicated on Drawings.

.13 Install wall tile full wall height unless shown otherwise.

.14 Coordinate work of this Section with work of other Sections for items requiring to be recessed into work of this Section.

.15 Sound tiles after setting and remove and replace tiles not fully bedded.

.16 Re-point joints after cleaning to eliminate imperfections. Avoid scratching tile surfaces.

.17 Finished tile work shall be clean and free of tiles which are pitted, chipped, cracked or scratched. All damaged tile shall be removed and replaced.

.18 Where indicated on Drawings or as required, install continuous single piece metal edge trims centred under doors in closed position and other locations where tile meets other floor finishes.

.19 Allow tile to set for a minimum of 48 hours prior to grouting.

3.4 GROUTING

.1 Grout tiles in accordance with ANSI A108.10 and as specified herein.

.2 Mix grouts and install in strict accordance with the Manufacturer's instructions.

.3 Excess grout shall be removed from the surface of tiles using the edge of a rubber float held at a 45° angle, moving it diagonally to the joints. Fill all gaps and air holes.

.4 Do not allow grout to harden on face of tile. Refer to Manufacturer's instructions for thorough removal.

3.5 CONTROL JOINTS AND SEALING

.1 Control joints of a flexible caulking material shall be placed every 4877mm to 6096mm (16 to 20') apart, directly over existing control joints and/or where indicated on Drawings or as required in accordance with TTMAC Detail No. 301MJ-2019-2021, Details E, F and G, whichever is applicable. Control joints shall be placed around the floor perimeter at walls, around columns, and where tile abuts other hard materials or vertical surfaces. Saw cutting of tile after installation is prohibited. Tile shall be cut if required and installed along each side of control joints.

.2 Locate expansion, control, contraction, and isolation joints, as indicated below, unless specifically indicated otherwise on the Drawings:

.1 Interior: 5m (16’) maximum: 6mm (1/4") joint width.

.3 Joints around fixtures, pipes or other fittings shall be sealed with a sealant. Refer to Section 07 92 00 for type of sealants to be used.

.1 Colour of sealant shall match grout as selected later by Consultant.

3.6 WATERPROOFING

.1 Install waterproofing in accordance with waterproofing Manufacturer's written instructions to produce a waterproof membrane of uniform thickness bonded securely to substrate.

.2 Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.7 CLEANING AND FINISHING

.1 Clean tiled areas after grouting has cured, using compatible solutions and methods as recommended by the Manufacturer.

.2 Remove grout residue from tile as soon as possible.

.3 Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout Manufacturer's written instructions, but no sooner than 10 days after installation.

.4 Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning.

.5 Flush surface with clean water before and after cleaning.

.6 Leave finished installation clean and free of cracked, chipped, broken, unbonded, or other tile deficiencies.

3.8 PROTECTION OF FINISHED WORK

.1 Protect installed work.

.2 Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of:
- .1 Acoustical panel ceiling systems (ACT).
- .2 Suspended metal grid ceiling system and perimeter trim.
- .3 Supplementary acoustic insulation over system units.
- .4 Site quality control.

1.3 RELATED REQUIREMENTS

.1 Section 09 21 16
.2 Section 09 90 00
.3 Division 20
.4 Division 26

1.4 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 American Society for Testing and Materials (ASTM):
- .1 ASTM C635/C635M, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
- .2 ASTM C636/C636M, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
- .3 ASTM E1264 Standard Classification for Acoustical Ceiling Products

.3 Underwriters Laboratories of Canada (ULC):
- .1 CAN/ULC S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.5 DESIGN AND PERFORMANCE REQUIREMENTS

.1 Suspension System:
- .1 Determine the superimposed loads that will be applied to suspension systems by components of the building other than the ceiling and ensure that adequate hangers are installed to support the additional loads in conjunction with the normal loads of the system.
- .2 Design supplemental suspension members and hangers where width of ducts and other construction within ceiling plenum produces hanger spacing that interferes with location of hangers at required spacing to support standard suspension system members:
  - .1 Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

.3 Design suspended ceiling system for adequate support of electrical fixtures as required by Electrical Safety Authority.

.4 Rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of L/360.

.5 Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions as required for this post-disaster building and determined according to applicable code and requirements of authorities having jurisdiction.

.6 Surface-Burning Characteristics: Conform to CAN/ULC S102 or ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.6 ADMINISTRATIVE REQUIREMENTS

.1 Coordinate layout and installation of ceilings with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, and fire-suppression system.

1.7 SUBMITTALS FOR REVIEW

.1 Submit submittals in accordance with the General Conditions and Section 01 33 00.

.2 Product Data: Submit product data for each type of product specified.

.3 Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling mounted items indicating the following:

.1 Ceiling suspension system members.

.2 Method of attaching suspension system hangers to building structure.

.3 Ceiling mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; and special mouldings at walls, column penetrations, and other junctures of acoustic ceilings with adjoining construction.

.4 Samples:

.1 Submit two 300 x 300mm samples illustrating material and finish of each type of acoustic unit.

.2 Submit two 300mm long samples of suspension system main runner, cross runner, and perimeter moulding.

1.8 SUBMITTALS FOR INFORMATION

.1 Qualifications Data: For Installer.

.2 Installation Data: Manufacturer's special installation requirements, including perimeter conditions requiring special attention.

.3 Professional Structural Engineer’s Letters of Assurance:

.1 Provide letters or completed Owner-prescribed forms signed by the Professional Structural Engineer used to prepare the shop drawings, stating that the ceiling system has been designed accordance with the structural performance requirements of the applicable codes, including verification that:

.1 Specified products have been used.

.2 Designs and installations as tested, have been installed on the Project.
.3 Loads and movement requirements have been achieved.

1.9 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Stock Materials:
  .1 Acoustical Ceiling Units: Full size units equal to three percent of quantity installed, of each tile type.
  .2 Suspension-System Components: Quantity of each concealed grid and exposed component equal to three percent of quantity installed.

1.10 QUALITY ASSURANCE

.1 Conform to Ceilings and Interior Systems Contractors Association (CISCA) Ceiling Systems Handbook requirements.

.2 Qualifications of Installer: Approved by suspension system Manufacturer.

1.11 REGULATORY REQUIREMENTS

.1 Conform to applicable code for combustibility requirements for materials.

.2 Conform to applicable code for seismic requirements for ceiling system.

1.12 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off-the-ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store material in original, undamaged containers or wrappings with Manufacturer's seals and labels intact.

1.13 SITE CONDITIONS

.1 Ambient Conditions: Install acoustic unit ceilings only when building is enclosed, has sufficient heat, when overhead mechanical and electrical work is complete, and dust and moisture producing activities are complete; maintain uniform temperatures and relative humidity within range recommended by material Manufacturer from the time of installation until Substantial Performance for the project; make adjustments to temperature and humidity gradually within tolerances indicated by Manufacturer.

1.14 WARRANTIES

.1 Provide 2 year warranty by Manufacturer of acoustic panels covering defects in products and failure to meet specified requirements.

2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section, Manufacturers offering products that may be incorporated into the Work include the following:
- .1 Armstrong Ceiling & Wall Solutions
- .2 CertainTeed Gypsum Canada Inc. a Division of Saint-Gobain
- .3 CGC Inc. a USG Company
- .4 Rockfon LLC

2.2 METAL SUSPENSION SYSTEMS

.1 Grid Components: ASTM C635/C635M, intermediate duty; exposed, downward access removable T; components die cut and interlocking; minimum 38mm high bulb tee design.
- .1 Recycled Content: minimum 50%.

.2 Grid Materials: Hot dip galvanized steel with factory applied powder-coated finishes.

.3 Grid Finish Colour: Blizzard White.

.4 Module: Sized as appropriate to acoustic panel size.

.5 Mouldings:
- .1 Perimeter Moulding: Formed to provide angle profile moulds unless shown otherwise, with matching finish and colour to grid.

.6 Exposed Suspension System (Type 1): Provide standard exposed 'T' bar system: G30 hot-dipped galvanized steel with powder coated finish for exposed surfaces in Blizzard White colour.
- .1 Acceptable Product:
  - .1 ‘Prelude XL 15/16”’ by Armstrong Ceiling & Wall Solutions.

2.3 ACOUSTIC CEILING PANELS (ACT)

.1 Provide Manufacturer's standard panels of configuration indicated that comply with ASTM E1264 classifications as designated by the nominal values for types, patterns, acoustic ratings, and light reflectance class, unless otherwise indicated.

.2 Surface burning properties, all types: Flame spread of 25 or less and smoke developed of 50 or less when tested in accordance with CAN/ULC S102, substantiated by ULC labels on materials supplied.

.3 Acoustic Panel (ACT-1): ASTM E1264, Type IV, Form II, Pattern E:
- .1 Performance:
  - .1 NRC: Min. 0.80.
  - .2 Thickness: 22mm.
  - .3 Surface Texture: Fine.
  - .4 Surface Colour: White.
- .2 Edge Profile: Square.
- .3 Sizes: 610 x 610mm.
- .4 Suspension System: Type 1.

.5 Approved Product:
.1 'ULTIMA High NRC' by Armstrong Ceiling & Wall Solutions.

2.4 ACCESSORIES

.1 Accessories: Stabilizer bars, clips, perimeter mouldings and splices required for suspended grid system.
.1 Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
.2 Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

.2 Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

.3 Ties Wire: minimum 1.98mm (14 ga.) Ø steel wire, galvanized.
.1 Hanger Attachments to Concrete: 1 #12 galvanized annealed steel wire for support of a maximum weight of 68kg per hanger; #9 galvanized annealed steel wire for support of a maximum weight of 140kg per hanger; 4.5mm diameter galvanized annealed steel rod to support a maximum weight of 250kg per hanger.

.4 Anchors: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E488 by an independent testing agency; Minimum tensile strength 390 MPa.

.5 Acoustic Sealant for Perimeter Mouldings: As specified in Section 07 92 00.

3 Execution

3.1 EXAMINATION

.1 Verify existing conditions before starting work.

.2 Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION – GENERAL

.1 Install acoustical ceilings according to CISCA publication Ceiling Systems Handbook.

3.3 INSTALLATION - LAY-IN GRID SUSPENSION SYSTEM

.1 Install suspension system to manufacturer instructions and ASTM C636/C636M, and as supplemented in this Section.

.2 Install system in accordance with ASTM E580/E580M.

.3 Install system capable of supporting imposed loads to a deflection of L/360 maximum.

.4 Lay out system to a balanced grid design with edge units no less than 50% of acoustic unit size, unless otherwise detailed.

.5 Install after major above ceiling work is complete. Coordinate the location of hangers with other work.

.6 Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

.7 Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

.8 Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 150mm of each corner; or support components independently.

.9 Do not eccentrically load system or produce rotation of runners.

.10 Perimeter Moulding:
- .1 Install edge moulding at intersection of ceiling and vertical surfaces into bed of acoustic sealant.
- .2 Use longest practical lengths.
- .3 Overlap corners.
- .4 Provide at junctions with other interruptions.

3.4 INSTALLATION - ACOUSTIC UNITS

.1 Install acoustic units to Manufacturer's instructions.

.2 Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.

.3 Install units after above ceiling work is complete.

.4 Install acoustic units level, in uniform plane, and free from twist, warp, and dents.

.5 Cutting Acoustic Units:
- .1 Cut to fit irregular grid and perimeter edge trim.

.6 Where round obstructions occur, provide preformed closures to match perimeter moulding.

.7 Where indicated, lay acoustic insulation for a distance of 1 200mm either side of acoustic partitions.

.8 Install panel hold-down clips, where specified, to retain panels tight to grid system.

3.5 ERECTION TOLERANCES

.1 Maximum Variation from Flat and Level Surface: 3mm in 3m.

.2 Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2°.

3.6 SITE QUALITY CONTROL

.1 Engage a Professional Structural Engineer experienced in design and installation of this work and licensed in the Province where the Project is located to:
- .1 Perform timely and regular inspections.
- .2 Verify installation conforms to applicable code.
- .3 Prepare and submit inspection reports.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes requirements for supply and installation of Athletic Flooring, and accessories.

1.3 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 American Society for Testing and Materials (ASTM):
- .1 ASTM F1859, Standard Specification for Rubber Sheet Floor Covering Without Backing.
- .2 ASTM F1861, Standard Specification for Resilient Wall Base.
- .3 ASTM F1869, Standard Test Method for Measuring Moisture Vapour Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

.3 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Close spaces to traffic during flooring installation and until time period after installation recommended in writing by Manufacturer; install flooring and accessories after other finishing operations, including painting and ceiling construction have been completed.

.2 Pre-Installation Conference: Conduct conference at Project site in accordance with requirements of Section 01 31 19, to verify project requirements, substrate conditions, patterns and layouts, coordination with other Sections affected by work of this Section, Manufacturer's installation instructions and manufacturer's warranty requirements.

1.5 SUBMITTALS

.1 Submit submittals in accordance with the General Conditions and Section 01 33 00.

.2 Action Submittals:
- .1 Product Data: Submit one copy of product data for each type of product specified.
- .2 Shop Drawings: Submit shop drawings indicating:
  - .1 Location of seams and edges.
  - .2 Location of columns, doorways, enclosing partitions, built-in furniture, cabinets, and cut-out locations.
  - .3 Type and style of resilient transition strip used between adjacent flooring types.

.3 Samples for Selection: Submit Manufacturer's colour charts and samples for initial selection consisting of full range of colours and patterns available for each type of product indicated.

.4 Samples for Verification:

.1 Athletic Flooring: Submit samples of each different specified product for verification of colour and pattern in Manufacturer's standard size, but not less than 6” x 6” in size for tile or sheet material, or 6” long for resilient accessories.

.3 Informational Submittals: Provide the following submittals during the course of the work:

.1 Site Quality Control Test Results: Submit results or moisture emission testing of concrete subfloors prior to installation of flooring. Results shall include comparison of Manufacturer’s recommended moisture content to actual moisture vapour emission rate.

.4 Maintenance Data and Operating Instructions:

.1 Operation and Maintenance Data: Submit Manufacturer’s written instructions for maintenance and cleaning procedures, include list of Manufacturer’s recommended cleaning and maintenance products, and name of original Installer and contact information in accordance with Section 01 33 00.

.5 Safety Data Sheets:

.1 Submit WHMIS safety data sheets for incorporation into the Operation and Maintenance Manual. Keep one copy of WHMIS safety data sheets on site for reference by workers.

.6 Maintenance Materials:

.1 Provide 5% of each colour of athletic flooring and 30'-0" lineal feet coil stock of each colour of athletic flooring base specified, boxed and labelled.

.2 Store maintenance materials on the premises as directed by the Owner.

1.6 QUALITY ASSURANCE

.1 Contractor executing work of this Section shall have a minimum of 5 years continuous Canadian experience in successful and installation of work of type and quality shown and specified. Submit proof of experience upon Consultant's request.

.2 Athletic Flooring Installer: Use an Installer who is competent in heat welding and have a minimum of 5 years documented experience in the installation of athletic flooring and seams in accordance with Manufacturer’s training or certification program:

1.7 DELIVERY, STORAGE AND HANDLING

.1 Coordinate deliveries to comply with Construction Schedule and arrange ahead for off-the-ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store material in original, undamaged containers or wrappings with Manufacturer's seals and labels intact.

.4 Restrict traffic by other trades during installation.

.5 Provide adequate protection of completed tiled surfaces to prevent damage by other trades until final completion of this project. Minimum protection shall consist of kraftpaper.

1.1 ENVIRONMENTAL CONDITIONS

.1 Temperature of room, floor surface and materials shall not be less than 21°C for 48 hours before, during and for 48 hours after installation. Concrete floors shall be aged for a minimum of 28 days and shall be dry before application of the resilient floor tile.

.2 Moisture content of floor shall not exceed a maximum of 3lbs. of water per 1,000ft² of concrete slab area over a 24 hour period as measured by one of the following methods, as approved by Consultant:

- .1 Rubber Manufacturer's Association (RMA) moisture test using anhydrous calcium chloride.
- .2 Does not exceed 3% as measured by Calcium Carbide Hygrometer procedure.
- .3 Does not exceed 5% as measured by normal Protimeter.

.3 Avoid exposure to high humidity, cold drafts and abrupt temperature changes.

1.2 WARRANTY

.1 Warrant the work of this Section against defects in materials and workmanship in accordance with the General Conditions but for an extended period of 5 years and agree to repair or replace faulty materials or work which become evident during warranty period without cost to the Owner. Defects shall include, but not limited to, bond failure, and extensive colour fading.

2 Products

2.1 MANUFACTURERS

.1 Basis-of-Design Manufacturers: Manufacturers named in this Section were approved to provide work specified in this Section. Additional Manufacturers offering similar products may be incorporated into the work of this Section provided they meet the performance requirements indicated and provided requests for substitution are provided in accordance with Section 01 25 16.

.2 Approved manufacturers:

- .1 Flexco.
- .2 Mondo Sport & Flooring.
- .3 Compass Flooring.
- .4 Gym-Con.
- .5 Roppe Corporation.
- .6 Edgewood Athletics.
- .7 Tarkett.

2.2 DESCRIPTION

.1 Regulatory Requirements:
- .1 Provide Product with following flame spread rating and smoke developed rating when tested in accordance with following standards:
  - .1 Critical Radiant Flux (ASTM E648): > 0.45 watts/cm^2 – Class I.
  - .2 Smoke Developed (ASTM E662): ≤ 450.
  - .3 Maximum Flame Spread (CAN/ULC-S102.2-M): ≤ 100.

.2 Design and Performance Requirements:
- .1 Provide Products free from blisters, cracks, chipped edges and corners, embedded foreign matter or other defects.
- .2 Static Load Capacity: ASTMF970, Exceeds 10.54kg/cm^2 (150 psi).

2.3 MATERIALS

.1 Athletic Sheet Flooring (ASF-1 and ASF-2):
- .1 Prefabricated resilient athletic flooring, calendered and vulcanized, with a base of natural and synthetic rubbers, stabilizing agents and pigmentation.
  - .1 Basis-of-Design: “Mondo Sport Impact 10 mm” by Mondo Inc.
- .2 Size: Manufacturer's standard-size square tile, not less than 914mm (36”) square. Sheet Products may be used in lieu of tile subject to conformance with performance and aesthetic requirements of Specifications.
- .3 Colours and Patterns: Refer to Section 09 06 00 for ASF-1 and ASF-2.

2.4 ACCESSORIES

.1 Resilient Wall Base (VB-1): Smooth, buffed exposed face and ribbed or grooved bonding surface supplied in maximum practical length, with pre moulded end stops and external corners to match base, conforming to ASTM F1861 and as follows:
- .1 Type: TV – Thermoplastic Vinyl.
- .2 Group: 1 – Homogeneous.
- .3 Style: A – Straight.
- .4 Height: 150mm (6”).
- .5 Thickness: 3mm (1/8”).
- .6 Length: Manufacturer’s standard maximum length.

.2 Resilient Transition and Edge Strips: Extruded vinyl shapes meeting or exceeding AODA Recommendations for change of level transitions for transition between floors finishes having different levels, such as between resilient flooring on underlayment to carpet with no cushion or underlayment; acceptable materials as follows:
- .1 The following list is included to indicate the most commonly used transition and edge strip accessories; additional materials may be required where transition heights differ from the products listed and shall be included as a part of the Contract.
  - .1 Transition Strip (TS1) – Athletic Flooring to Epoxy Flooring Transition: Johnsonite Reducer CRS-XX-B by Tarkett between

flooring materials having dissimilar thicknesses. Colour: To be selected from Manufacturer's standard range.

.3 Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by Manufacturer for applications indicated. Do not use gypsum based materials.

.1 Underlayment: "Ultra/Plan" by Mapei Inc. or approved equivalent by Ardex Engineered Cements, or approved alternate.

.2 Patching Compound: "Plani/Patch" by Mapei Inc. or approved equivalent by Ardex Engineered Cements, or approved alternate).

.4 Sub-Floor Filler for smoothing, patching, filling cracks, holes, voids and depressions: Fast setting cementitious patching compound requiring water only to produce cementitious paste to Manufacturer's recommendations. Provide "Plani/Patch" by Mapei Inc. or equivalent by Ardex Engineered Cements (or approved alternate).

.5 Moisture Reduction Barrier: Application of systems for reduction of moisture vapour transmission and alkalinity control for concrete slab required to receive floor covering specified under this Section to be as follows:

.1 Moisture Vapour Emission Rate (MVER) Range: Ensure items provided are capable of treating high moisture vapour transmitting concrete surfaces up to 11.34kg/93m² (25lbs/1000ft²) in 24 hours; maximum relative humidity: 100%; as determined by ASTM F1869 test.

.2 Final Product selection to suit the conditions encountered at the time of installation. Where applicable, Provide the Manufacturer's floor leveling systems for use with specified Products.

.3 Provide one of the following:

.1 "Planiseal Series – Moisture Barrier Systems" by MAPEI Inc.;

.2 "Ardex Moisture Control Systems" by Ardex Engineered Cements;

.3 "Koester VAP I - 2000" by Koester USA Moisture Control System.

.4 Approved proprietary equivalent moisture control system recommended in writing by floor covering Manufacturer and approved by the Consultant in order to authenticate floor covering warranties.

.6 Primers and Adhesives: Low-VOC, waterproof of types recommended by rubber flooring Manufacturer and compatible with applied curing material for specific material on applicable substrate, above, on or below grade.

3 Execution

3.1 EXAMINATION

.1 Site Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify the Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work. Comply with the Manufacturer's recommendations including the following:

.1 Substrates conditions (clean, dry, free of depressions, raised areas or other defects which would telegraph through the installed resilient material).
.2 Temperature of resilient materials and substrate.
.3 Moisture conditions and adhesive bond tests.
.4 Confirmation that curing, hardening, and sealing compounds have not been used on concrete. Remove such compounds before proceeding.
.5 Confirmation that vapor barrier below slab has been installed for applications on concrete slabs-on-grade or below grade. Do not proceed with work unless written confirmation of such conditions is received and submitted.

.2 Pre-installation Testing:
.1 Calcium Chloride Test:
.1 Perform calcium chloride test in accordance with requirements of ASTM F1869 immediately prior to installation of linoleum flooring for moisture on concrete floors around perimeter of areas, at columns, and where moisture may be anticipated.
.2 Conduct 1 test for every 93m² (1000ft²) of flooring. Moisture emission from concrete floor shall not exceed 1.5kg/93m² (3.5 lbs/1000ft²) in 24 hours. Do not proceed with installation until moisture problems have been corrected. Provide results to the Consultant in writing prior to commencement of the installation.
.2 Relative Humidity Test:
.1 Perform relative humidity test in accordance with requirements of ASTM F2170 using in situ probes and measure internal relative humidity of slab. Ensure concrete slab and air space above floor slab are at service temperature and that relative humidity of area is similar to the Project's final conditions for 48 hours prior to measuring concrete relative humidity.
.2 Conduct minimum of 3 tests for first 1,000ft² and one additional test for each 1,000ft². Conduct one test near the center and others around the perimeter of area.
.3 Ensure relative humidity probe test results do not exceed 75% unless recommended otherwise by the flooring Manufacturer(s) in writing. Do not proceed with installation until moisture problems have been corrected. Provide results to the Consultant prior to commencement of installation.
.3 Acidity and Alkalinity Test:
.1 Conduct pH test in accordance with ASTM F710 to ensure alkali salt residue is within limitations acceptable to Manufacturer and to avoid adhesive failure, discoloration, shrinkage and softening of floor covering.
.2 If pH results are higher than acceptable to Manufacturer, neutralize floor prior to the beginning of installation. Neutralize floor by sanding, vacuuming and by application of water and mild muriatic acid as recommended by Manufacturer. Retest to ensure pH levels have been neutralized.

.3 Provide acidity and alkalinity test at same frequency and at each location in which calcium chloride and relative humidity testing is performed. Do not proceed

with installation until acidity problems have been corrected. Provide results to the Consultant prior to commencement of installation.

3.2 PREPARATION

.1 Clean athletic flooring substrates free of loose and adhered material perfectly clean and in accordance with athletic the flooring manufacturer's instructions.

.2 Ensure concrete substrates are dry after performing tests as specified herein before using methods recommended by athletic flooring and adhesive Manufacturers, and that they exhibit no alkalinity, carbonization, dusting or scaling.

.3 Remove subfloor ridges and bumps to make substrate flush with adjacent subfloor.

.4 Moisture Barrier:

- .1 Apply moisture reduction barrier at following locations:
  - .1 Basement slabs and Slabs-on-grades (regardless of pre-installation moisture testing results).
  - .2 Suspended slabs where slab moisture contents are above those recommended by floor covering Manufacturers at time of installation after performing pre-installation testing.
- .2 Prior to applying moisture barrier, mechanically prepare concrete substrate using dustless approved method to ICRI requirements to CSP (Concrete Surface Profile) #2 (Diamond Cup Ground) or #3 (Shotblasted).
- .3 Apply moisture barrier in accordance with Manufacturer’s recommendations across entire surface being treated including up to and around perimeter of restrained surfaces such as walls and columns.
- .4 Do not proceed with work until unsatisfactory conditions have been resolved.
- .5 Fill depressions, dished areas, low spots, voids, gaps, cracks, joints, holes and other substrate defects with underlayment, flat, even and flush with adjacent substrate.
- .6 Provide cementitious underlayment to achieve a flat substrate to within 3mm (1/8") total maximum deviation along 3000mm (10') straight edge applied omni-directionally over entire floor area.
- .7 Provide a flat, smooth 600mm (24") wide underlayment strip at junction of athletic flooring with other finish flooring materials for a flush transition at the meeting edge. Feather strip edges to conceal perimeters.

3.3 INSTALLATION

.1 Install flooring as recommended by the material Manufacturer.

.2 Locate junctions of dissimilar flooring between rooms (i.e., same material but different colour, or different material) at door opening centrelines.

.3 Loose lay tiles over area to be covered in staggered pattern and with tile pattern running as directed by the Consultant. Make cuts to fit tile at perimeter and at penetrations.

.4 Apply adhesive and embed tiles. Do not pressure fit tiles. Remove excess adhesive.

.5 Install flooring flush with floor plates, cleanout covers and other fitments in floor.

.6 Roll floor diagonally to expel entrapped air.

.7 Weigh down tile seams and corners if recommended by Manufacturer until adhesive has set.

.8 Layout resilient accessories as follows:
- .1 Install edge strips at unprotected and exposed edges where flooring terminates.

.9 Accurately scribe tile around walls, and other floor conditions.

.10 Each type of material used shall be from one Manufacturer throughout the work and material in each area shall be of same production run.

.11 Remove and replace loose, damaged and defective tiles where required and as directed by Consultant.

3.4 CLEANING

.1 Remove adhesive from surface of flooring as work progresses.

.2 Protect newly laid flooring from construction traffic for a period of 7 Days to allow flooring to bond firmly. Do not wash newly laid floor covering for minimum of 7 Days after installation to allow adhesive to set and dry. Afterwards, thoroughly clean surfaces in accordance with Manufacturer's directions using cleaners as recommended by material Manufacturer.

.3 Provide and maintain necessary protection of finished athletic flooring and bases. Replace damaged athletic flooring and bases with new materials at no additional cost.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Trowel application of epoxy flooring, including surface preparation, primer, aggregate topping, grout coat, and finish coat.

.2 Repair of floor prior to application of EPX-3.

1.3 RELATED WORK SPECIFIED ELSEWHERE

.1 Contractor shall be responsible for co-ordinating this Section with all related sections.

1.4 EXAMINATION

.1 Examine all areas and conditions affecting work of this Section and report any discrepancies or defects which would affect finished results.

1.5 QUALITY ASSURANCE

.1 Sub-Contractor executing work of this Section shall employ Installers having a minimum of 5 years continuous Canadian experience in successful installation of work of type and quality shown and specified. Submit proof of experience upon Consultant's request.

.2 Work of this Section shall be executed by workers especially trained and experienced in this type of work. Have a full time, senior, qualified representative at the Site to direct the work of this Section at all times. Representative shall meet Consultant's approval.

.3 Ensure proper use of proprietary materials in strict accordance with the material Manufacturer's directions. It shall be the responsibility of the material Manufacturer or Supplier to furnish these directions to the Contractor and to check periodically at the site to ensure that they are being carried out.

1.6 PRE-INSTALLATION CONFERENCE

.1 Contractor shall hold pre-installation conference 2 weeks prior to commencing work of this Section. Conference shall be attended by the Contractor, Owner, Consultant, concrete finishing Sub-Contractor, epoxy flooring Installers and epoxy Manufacturer's representative to discuss the following, but not limited to the following:

- .1 Substrate conditions, non-structural cracks, structural cracks and preparation requirements.
- .2 Floor surface irregularities and levelness tolerances, including all remedial requirements.
- .3 Installation of epoxy flooring.
- .4 Edge details and treatments.

.5 Inspections during the work.
.6 Protection of epoxy flooring work.

.2 Contractor shall ensure that Manufacturer's representatives issues written installation instructions at the pre-installation conference, to all parties attending the pre-installation conference and the Consultant, for all Epoxy required for the work of this Section.

.3 Contractor shall within 72 hours of the pre-installation conference, prepare minutes of the conference, and issue minutes to all parties attending the pre-installation conference and the Consultant. Contractor shall clearly indicate required actions and by which party.

1.7 SUBMITTALS

.1 Provide submittals specified and as required to assess conformance with the Contract Documents, in accordance with the General Conditions and Division 01 of the Specifications.

.2 Samples:
.1 Submit sample panel 610mm x 610mm (24" x 24") of epoxy flooring adhered to a rigid board. Identify samples by project number, date, name of Sub-Contractor and tile type.
.2 Upon Consultant's request submit samples of base, trim and fittings.

.3 Safety Data Sheets:
.1 Submit WHMIS safety data sheets for inclusion with project record documents. Keep one copy of WHMIS safety data sheets on Site for reference by workers.

.4 Maintenance Instructions:
.1 Upon completion of the Work, furnish Consultant with copies of maintenance instructions, containing complete detailed and specific instructions for maintaining, preserving and keeping clean the surfaces of this Work and in particular, giving adequate warning of maintenance practices of materials detrimental to the work of this Section for inclusion in the Operation and Maintenance Manual.

1.8 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.3 Store material in original, undamaged containers or wrappings with Manufacturer's seals and labels intact.

.4 Restrict traffic by other trades during installation.

.5 Provide adequate protection of completed epoxy surfaces to prevent damage by other trades until final completion of this project. Minimum protection shall consist of 4 mil polyethylene sheets lapped 100mm (4") and taped.

1.9 WARRANTY

.1 Warrant the work of this Section against defects in materials and workmanship in accordance with the General Conditions, but for a period of 2 years, and agree to promptly make good defects which become evident during the warranty period without cost to the Owner. Defects shall include but not be limited to the following: Cracking, crazing, discolouration, staining.

2 Products

2.1 GENERAL

.1 All components and products of the epoxy flooring system shall be manufactured and supplied by a single Manufacturer, to ensure compatibility between components.

2.2 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials specified, and subject to review and acceptance by Owner in accordance with Section 01 25 16, Manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- .1 Stonhard
- .2 Sika Canada
- .3 Master Builders Canada

2.3 MATERIALS

.1 Refer to Section 09 06 00 for Basis-of-Design products and colours.

.2 EPX-1:
- .1 Basis of Design Materials: Stonblend GSI by Stonhard, nominal thickness of 5mm (3/16”), comprising of:
  - .1 Primer: A two-component, 100% solids, epoxy primer.
  - .2 Mortar Base: One coat of three-component, 100% solids, troweled mortar consisting of epoxy resin, with pigmented quartz blended aggregate.
  - .3 Grout Coat: One coat of two-component, 100% solids, clear epoxy resin.
  - .4 Sealer: One coat of two-component, 100% solids, clear, matte epoxy sealer.
  - .5 Top Coat: Two coats of two-component, 100% solids, clear, matte, water-based, low VOC, aliphatic polyurethane coating.
- .2 Provide 150mm (6”) high cove base.

.3 EPX-2:
- .1 Basis of Design Materials: Stonshield HRI by Stonhard, nominal thickness of 5mm (3/16”), comprising of:
  - .1 Mortar Base: A four-component, troweled mortar consisting of epoxy resin, curing agent, and finely graded silica aggregate.
  - .2 Undercoat: A three-component, free flowing epoxy formulation consisting of resin, curing agent, pigment and fine aggregate.

.3 Aggregate: Brightly coloured, quartz broadcast aggregate.
.4 Clear Epoxy Sealer: A two-component, high-performance, UV-resistant, clear epoxy sealer.

.2 Provide 150mm (6”) high cove base.

.4 EPX-3:

.1 Basis of Design Materials: Stonkote GS4 by Stonhard:
.1 Composition: Two-component, solvent-free epoxy coating.
.2 Minimum total thickness: 0.5mm (0.020”) dry film thickness.
.3 Number of Coat: Two (2).
.4 Texture: Texture 2, slip resistant.

.2 Provide 150mm (6”) high cove base.

.3 Prior to application of epoxy flooring, apply two-component, flexible, epoxy membrane designed for dynamic crack isolation membrane: Stonproof CT5 by Stonhard.

3 Execution

3.1 EXAMINATION

.1 Examine surfaces and conditions under which flooring is to be applied. Moisture content of surfaces and building air temperatures must be within limits recommended by the flooring Manufacturer. Do not start work until unsatisfactory conditions have been corrected. Application of materials indicates acceptance of surfaces.

.2 Surfaces shall be free of membrane curing compounds, laitance, dust, dirt, grease, oil and other contaminants that may affect proper adhesion of the coating.

.3 Do not apply coating system if ambient temperature is below 10°C (50°F) or above 32°C (90°F) or if relative humidity is above 80%.

3.2 SURFACE PREPARATION

.1 Remove projections and other conditions that may affect the installation of the flooring system.

.2 Protect adjacent surfaces, fixtures and equipment with drop cloths or masking as necessary to prevent damage from surface preparation.

3.3 INSTALLATION - EPX-1 AND EPX-2

.1 Prepare, mix materials and apply each component of flooring system in strict accordance with manufacturer's printed directions to produce uniform monolithic wearing surface of thickness indicated for each system, with integral cove bases, uninterrupted except at divider strips, sawn joints or other types of joints required.

.2 Apply flooring with care to ensure that no laps, pin holes, voids, crawls, skips or other marks or irregularities are visible, and to provide uniform appearance.

.3 Work coating into corners and other restricted areas, up and over equipment bases, and into recesses in floors to ensure full coverage.

.4 Make clean true junctions with no visible overlap between adjoining applications of coatings.

.5 Match approved sample for colour, sheen, texture and slip resistance.

.6 For large areas, stop each day's production at metal dividing strip at lines approved Consultant.

.7 Primer: Apply primer over prepared substrate, at Manufacturer's recommended spreading rate with timing of application coordinated with subsequent application of topping mix to ensure optimum adhesion between flooring materials and substrate.

.8 Trowel Applied Epoxy Matrix: Combine aggregate to blended epoxy resin to form trowellable mortar. Trowel apply mix over tacky primer in number of coats and at spreading rates required to produce minimum thickness specified. Allow topping to harden minimum time recommended by Manufacturer before applying finish coats.

.9 Epoxy/Epoxy Grout Top Coats: When trowelled epoxy matrix has hardened, remove imperfections by lightly abrading surface and vacuum clean. Apply 2 finish coats at spreading rate and following method recommended by Manufacturer to achieve 0.254mm (10 mils) minimum thickness and to obtain specified finish to match approved samples. Allow minimum recommended drying time between coats.

.10 Cove Base: Terminate base 150mm (6") high, feather out and trim evenly along wall to provide smooth transition with adjacent wall finish. Ensure top coat is compatible with wall coating prior to application. Round interior and exterior corners.

.11 Allow sufficient final cure time, as recommended by flooring Manufacturer, before opening to traffic.

3.4 INSTALLATION - EPX-3

.1 Mix and apply work in strict accordance Manufacturer's printed directions in specified thickness, with integral cove bases, uninterrupted except at sawn joints or other types of joints required, free of laps, pin holes, voids, crawls, skips or other marks or irregularities are visible, and to provide uniform appearance.

.2 Work coating into corners and other restricted areas, up and over bases, and into recesses in floors to ensure full coverage.

.3 Make clean true junctions with no visible overlap between adjoining applications of coatings.

.4 Apply dynamic crack isolation membrane in accordance with Manufacturer’s instructions and recommendations to repair existing floor cracks.

.5 Primer: Where recommended by Manufacturer, apply primer over prepared substrate, at manufacturer's recommended spreading rate with timing of application co-ordinated with subsequent application of topping mix to ensure optimum adhesion between flooring materials and substrate.

.6 Finish coats: Apply minimum of two finish coats at spreading rate recommended by Manufacturer to achieve minimum total thickness specified. Allow minimum recommended drying time between coats.

.1 Base Coat: Apply base coat and immediately broadcast aggregates and back roll to obtain slip-resistant texture finish. Let dry.

.2 Top Coat: Apply top coat to dry base coat for consistent appearance.

.7 Cove Base: Provide 150mm (6") high cove base struck straight to provide line for wall finish.

.8 Floor Drains: Slope flooring to drains minimum of 1:100 from furthest surface point.

.9 Allow sufficient final cure time, as recommended by flooring Manufacturer, before opening to traffic.

3.5 CLEANING AND FINISHING

.1 Clean flooring areas after completion, using compatible solutions and methods as recommended by the Manufacturer.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Provide labour, materials, tools and other equipment, services and supervision required to complete interior and exterior painting work.

.2 Surface preparation for this section will be limited to priming and back-priming, and specific pre-treatments noted in this section or as specified in the Master Painters Institute (MPI) Painting Specification Manual.

1.3 RELATED REQUIREMENTS

.1 Other Sections of the Specification requiring painting refer to this Section. Coordinate requirements of referencing Sections.

1.4 REFERENCE STANDARDS

.1 All references standards specified herein imply the latest edition of the standards.

.2 Environmental Choice Paints and Surface Coatings, Low VOC Product Listings Program (ECP):
- .1 Paints and Surface Coatings, Low VOC Product Listings

.3 The Master Painters Institute (MPI):
- .1 New Surfaces: Architectural Painting Specification Manual.
- .2 Existing Surfaces: Maintenance Repainting Manuals.

.4 The Society for Protective Coatings (SSPC):
- .1 Coating Materials Guidelines
- .2 Surface Preparation Guidelines
- .3 Application, Inspection and Quality Control Guidelines

1.5 DEFINITIONS

.1 Gloss Levels: Standard coating terms defined by MPI Manual apply to products of this Section as follows:
- .1 G1: Matte of Flat: Lustreless or matte finish with a gloss range below 10 when measured at 85° to meter and 0 to 5 when measured at 60°.
- .2 G2: Velvet: Matte to low sheen finish with a gloss range of 10 to 35 when measured at 85° to meter and 0 to 10 when measured at 60°.
- .3 G3: Eggshell: Low sheen finish with a gloss range of 10 to 35 when measured at 85° to meter and 10 to 25 when measured at 60°.
- .4 G4: Satin: Low to medium sheen with a gloss range of minimum 35 when measured at 85° to meter and 20 to 35 when measured at 60°.
- .5 G5: Semi-Gloss: Medium sheen finish with a gloss range of 35 to 70 when measured at 60° to meter.
- .6 G6: Gloss: High sheen finish with a gloss range of 70 to 85 when measured at 60° to meter.

.7 G7: High Gloss: Reflective sheen having a gloss range in excess of 85 when measured at 60° to meter.

.2 Gloss Values: Generally, provide paints and coatings having the following sheens when installed on the following substrates:
- .1 Walls: Eggshell (G3) or Satin (G4) as selected by Consultant at a later date.
- .2 Trim and Doors: Semi-gloss (G5).
- .3 Ceilings: Flat (G1).

1.6 SUBMITTALS

.1 Provide required information in accordance with Section 01 33 00.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:
- .1 Product Data: Submit list of all painting materials used for the Work to the Consultant for review prior to ordering materials for each paint system indicated, including block fillers and primers.
  - .1 Material List: An inclusive list of required coating materials indicating each material and cross reference specific coating, finish system, and application; identify each material by Manufacturer's catalogue number and general classification.
  - .2 Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- .2 Samples: Provide stepped samples, defining each separate coat, including block fillers and primers using representative colours required for the project; label each sample for location and application, and as follows:
  - .1 Drawdown Samples: Provide three drawdown sample charts (cards) for each type, texture and colour of finish specified for verification purposes before ordering paint materials.
- .3 Informational Submittals: Provide the following submittals when requested by the Consultant:
  - .1 Certification: Submit certification reports for paint products indicating that they meet or exceed low VOC and coloured base requirements listed in this Section.

1.7 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Submit copies of paint Manufacturer’s written maintenance information for inclusion in the operations manual in accordance with Section 01 33 00, including specific warning of any maintenance practice or materials that may damage or disfigure the finished Work.

.2 Maintenance Materials: Deliver maintenance materials to Owner in quantities indicated and in accordance with Section 01 33 00, that match products installed; packaged with protective covering for storage, and identified with labels describing contents and building location and as follows:
- .1 Paints and Coatings: Minimum of 4-4L containers of field colours and 4-1 L containers of each accent colour, and all remnants.

1.8 QUALITY ASSURANCE

.1 Conform to the standards contained in the MPI Manual.

.2 Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in service performance, and as follows:

- .1 Have a minimum of 5 years proven satisfactory experience and shall show proof before commencement of work that he will maintain a qualified crew of painters throughout the duration of the work.
- .2 When requested provide a list of the last three comparable jobs including, name and location, specifying authority, start and completion dates and cost amount of the painting work.
- .3 Apprentices may be employed provided they work under the direct supervision of a qualified Journeyman in accordance with trade regulations.

.3 Source Limitations: Obtain block fillers and primers for each coating system from the same Manufacturer as the finish coats and as follows:

- .1 Use only paint manufacturers and products as listed under the Approved Products section of the MPI Manual Architectural Painting Specification Manual.

1.9 ENVIRONMENTAL REQUIREMENTS

.1 Conform to MPI Manual and Manufacturers requirements.

.2 Perform no painting or decorating work when the ambient air and substrate temperatures, relative humidity and dew point and substrate moisture content is below or above requirements for both interior and exterior work.

.3 Apply paint only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.

.4 Ensure adequate continuous ventilation and sufficient heating and lighting is in place.

.5 Paint, stain and wood preservative finishes and related materials (thinners, solvents, caulking, empty paint cans, cleaning rags, etc.) shall be regarded as hazardous products. Recycle and dispose of same subject to regulations of applicable authorities having jurisdiction.

.6 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into the ground retain cleaning water and filter out and properly dispose of sediments.

.7 Set aside and protect surplus and uncontaminated finish materials not required by the Owner and deliver or arrange collection for verifiable re-use or re-manufacturing.

1.10 WARRANTY

.1 Provide 5 years warranty on exterior and interior paint.

.1 Warrant that painting work has been performed in accordance with MPI Manual requirements.

2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers that have attained the prerequisites for ecologically sustainable labelling mark on their products and may be incorporated into the Work include; but are not limited to, the following:
- .1 Sherwin-Williams LLC
- .2 Benjamin Moore and Co. Limited
- .3 ICI Paints (Canada) Inc.
- .4 Para Paints
- .5 PPG Canada Inc.- Architectural Finishes
- .6 SICO Inc.

2.2 MATERIALS

.1 Primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, and other painting materials shall be in accordance with the MPI Manual “Approved Product” listing and shall be from a single Manufacturer for each system used.

.2 Materials such as linseed oil, shellac, and other accessory materials shall be the highest quality product of an approved Manufacturer listed in the MPI Manual and shall be compatible with other coating materials.

.3 All materials and paints shall be lead and mercury free and shall have low VOC content where possible.

.4 Colour and Manufacturer: As indicated in Section 09 06 00.

3 Execution

3.1 PREPARATION OF SURFACES:

.1 Prepare surfaces in accordance with MPI Manual requirements. Refer to the Manual for specific surface preparation requirements for each substrate material.

3.2 APPLICATION

.1 Paint when substrates and environmental conditions (heating, ventilation, lighting and completion of other work) are acceptable for applications of products specified in this Section.

.2 Paint and stain surfaces requiring paint or stain finish to Premium MPI Manual finish requirements with application methods in accordance with best trade practices for type and application of materials used.

.3 Continue paint finishes through behind wall mounted items.

.4 Painting coats specified are intended to cover surfaces satisfactorily when applied at proper consistency and in accordance with Manufacturer’s recommendations.

.5 Apply a minimum of four coats of paint where deep or bright colours are used to achieve satisfactory results.

3.3 EXTERIOR SURFACES

.1 Paint exterior surfaces in accordance with the MPI Manual painting systems listed in this Section.

.2 Plywood Hoarding:
.1 EXT 6.4G: Latex (over alkyd / oil primer), G1 finish.

.3 Steel and Iron Decorative Metal Railings:
.1 EXT 5.1R: W.B. Light Industrial coating (over epoxy primer and high build epoxy), G5 finish.

.4 Galvanized Metal (doors, frames, miscellaneous steel, flashing, bollards):
.1 EXT 5.1T: Pigmented polyurethane and self-priming epoxy.

3.4 INTERIOR SURFACES

.1 Paint interior surfaces in accordance with the MPI Manual painting systems listed in this Section.

.2 Plywood Hoarding:
.1 INT 6.4A: Latex (over alkyd primer / sealer), G1 finish.

.3 Concrete Masonry Units:
.1 INT 4.2D: High Performance Architectural Latex coating.

.4 Structural Steel and Metal Fabrications:
.1 INT 5.1R - High performance industrial latex, G2 finish; G5 finish in high contact areas.

.5 Galvanized Metal (doors, frames, railings, misc. steel, pipes, overhead decking, ducts, etcetera):
.1 INT 5.3M: High performance architectural latex G5 finish.

.6 Gypsum Board (gypsum board, drywall, and other sheet gypsum materials):
.1 INT 9.2A: Latex G3 finish for walls and ceilings.
.2 INT 9.2B: High performance architectural latex G3 finish for walls in high contact areas.
.3 INT 9.2F - Waterborne epoxy (tile-like) G5 finish in wet areas.

3.5 MAINTENANCE REPAINTING

.1 Paint existing interior previously finishes surfaces in accordance with the MPI Manual painting systems listed in this Section.

.2 Interior Galvanized Metal (doors, frames, railings, misc. steel, pipes, overhead decking, ducts, gutters, flashing, etcetera):
.1 RIN 5.3A: Latex G5 finish.

3.6 MECHANICAL AND ELECTRICAL EQUIPMENT

.1 Paint “unfinished” conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and texture to match adjacent surfaces, in the following areas:
- .1 In exposed-to-view exterior and interior areas.
- .2 In interior high humidity interior areas.
- .3 In boiler room, mechanical and electrical rooms.

.2 Leave conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks in unfinished areas.

.3 Paint inside of ductwork where visible behind louvers, grilles and diffusers beyond sight line with primer and one coat of matt black (non-reflecting) paint.

.4 Paint the inside of light valances gloss white.

.5 Refer to Mechanical and Electrical Specifications for painting, banding, stencilling of other surfaces/equipment, and generally as follows:
- .1 Paint gas piping gas standard yellow where visible in service spaces.
- .2 Paint both sides and all edges of plywood backboards for equipment before installation.
- .3 Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- .4 Do not paint over nameplates.

3.7 SITE QUALITY CONTROL

.1 Painted surfaces will be considered to lack uniformity and soundness if any of the following defects are apparent at time of field review when viewed from a distance of 1220mm (4’) from the painted surface:
- .1 Runs, sags, hiding or shadowing by inefficient application methods.
- .2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.

.2 Painted surfaces will be considered as deficient if any of the following defects are apparent at time of field review, regardless of viewing distance.
- .1 Damage due to touching before paint is sufficiently dry or any other contributory cause.
- .2 Damage due to application on moist surfaces or caused by inadequate protection from the weather.
- .3 Damage or contamination of paint due to windblown contaminants (dust, sand blast materials, salt spray, etcetera).

.3 Painted surfaces found as unacceptable shall be replaced or repaired at no cost to the Owner or Consultant:
- .1 Small affected areas may be touched up.
- .2 Large affected areas or areas without sufficient dry film thickness of paint shall be repainted.
- .3 Runs, sags or damaged paint shall be removed by scraper or by sanding before application of new paint coats.

3.8 PROTECTION

.1 Protect newly painted exterior surfaces from rain and snow, condensation, contamination, dust, salt spray and freezing temperatures until paint coatings are completely dry.

.2 Curing periods shall exceed the Manufacturers recommended minimum time requirements.

.3 Erect barriers or screens and post signs to warn of or limit or direct traffic away or around work area as required.

3.9 CLEANUP

.1 Remove all paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

.2 Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.

.3 Remove combustible rubbish materials and empty paint cans each day and safely dispose of it in accordance with requirements of authorities having jurisdiction.

.4 Clean equipment and dispose of wash water or solvents, and other cleaning and protective materials (rags, drop cloths, masking papers, etcetera), paints, thinners, paint removers and strippers in accordance with the safety requirements of authorities having jurisdiction.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Furnish all labour and materials necessary for the completion of work in this Section as shown on the Contract Drawings and specified herein.

.2 Work in this Section includes but is not limited to:
- .1 Solid Phenolic Change Room Partitions
- .2 Hardware

1.3 RELATED REQUIREMENTS

.1 Section 05 50 00
.2 Section 09 21 16
.3 Section 10 28 13

1.4 SUBMITTALS

.1 Submit submittals in accordance with the General Conditions and Section 01 33 00.

.2 Shop Drawings:
- .1 Submit shop drawings showing and describing in detail materials, finishes, dimensions, details of connections and fastenings elevations, plans, sections, thicknesses, hardware and any other pertinent information.

.3 Samples:
- .1 Submit necessary templates and instructions where supports or anchors have to be built-in by others.
- .2 Submit one sample of each of the following:
  - .1 Hinge, latch, panel fitting.
  - .2 Corner section, 300mm x 300mm (12" x 12") showing colour, corner, edge and core construction.

1.5 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location.

.2 Do not permit delivery of work to job site until building is sufficiently dry, wet trades are completed and the moisture readings of surfaces in proposed storage area is less than 18%.

.3 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Store materials flat on level surface. Protect materials with suitable non-staining waterproof coverings but allow for air circulation at sides.

1.6 WARRANTY

.1 Warrant that the solid phenolic partitions and screens shall be free from defects in materials or workmanship in accordance with General Conditions for a period of minimum 10 years and agree to promptly make good defects by replacing defective solid phenolic partitions and screens in finish to match original finish and in a manner satisfactory to Owner. Defects shall include, but not be limited to, bubbling, delamination of faces, or edges, warp, twist, bow exceeding 1/4" and telegraphing of core. "Replace" as used herein includes installing panels, pilasters, hardware, shoes including hanging and fitting doors.

2 Products

2.1 MANUFACTURERS

.1 Basis-of-Design products are named in this Section; additional Manufacturers offering similar solid phenolic partition systems may be incorporated into the work provided they meet the performance requirements established by the named products.

.2 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, Manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 Floor-to-Ceiling Anchored Partitions:

.1 Solid Plastic Toilet Partitions, by Hadrian Inc.

.2 Black Core Phenolic Partitions, by ASI Global Partitions.

.3 Solid Phenolic DuraLine Series 1080G with Gap-Free Doors & Stiles, by Bobrick Washroom Equipment Inc.

2.2 MATERIALS

.1 Solid Phenolic, Melamine Surfaced, Panels, Pilasters and Doors:

.1 Plastic Laminate Face Sheets: High pressure, paper based, melamine surfaced, laminated plastic sheets, conforming to CAN3-A172-M, with thickness tolerances in accordance with Table 1 of CAN3-A172-M and plastic laminate grades as follows:

.1 Cores: Solid phenolic type core material. Thicknesses as specified herein.

.2 Privacy Strips or Interlocking Sightline-free design: Full height to eliminate sightline gaps.

.2 Bituminous Paint: Acid and alkali resistant bituminous isolation coating.

.3 Butyl Tape: Extruded, High grade macro-polyisobutylene tape of width and shore hardness to suit conditions.

.4 Building Paper: No.15 asphalt saturated, organic felt in accordance with CSA A123.3.

.5 Hardware and Fittings (Institutional):

.1 Hinges: 1.6mm thick (16 gauge) x 2" wide continuous stainless steel piano hinge with 1/8" diameter stainless steel pin and extends full height of doors.

.2 Door Latches: 2mm thick (14 gauge) stainless steel type slide type on nylon track, complete with occupancy indicator. Provide "C" type pulls at compartments for handicapped. Provide

.3 Door Keepers: 2.9mm thick (11 gauge) stainless steel type.

.4 Coat Hooks: Stainless steel type with rubber bumper on end.

.5 Doorstops: 2.9mm thick (11 gauge) stainless steel type designed to prevent the door from being kicked out of compartment.

.6 'U' Channels: 1.2mm thick (18 gauge) continuous 'U' shaped stainless steel channel extending full height of panels and screens.

.7 Hardware Material and Finish: Stainless steel shall be AISI 18-8 type 304 alloy conforming to ASTM A167.

.8 Hardware Fasteners: Vandal resistant, torks stainless steel machine screws installed from inside compartments. Door hardware shall also have factory installed threaded metal inserts in doors and pilasters.

.9 Provide reinforcement for washroom accessories as required to preserve integrity of partition panels and as required to ensure secure attachment of accessories.

.10 Top connection of pilaster for ceiling hung partitions shall consist of 3/4" diameter threaded rods complete with spacer and nuts and a 3" die-formed stainless steel pilaster shoe. Stainless steel shall be 0.024" thick, AISI type 304 stainless steel alloy conforming to ASTM A167-92b.

.11 Install matching 19mm (3/4") thick x 100mm (4") wide overhead bracing between pilasters for reinforcing. Fasten with stainless steel plates and screws on the inside of each stall.

2.3 FINISHES

.1 Partition Panel Colours:

.1 Refer to Section 09 06 00.

.2 Stainless Steel:

.1 AISI No.4 brushed finish.

2.4 FABRICATION AND MANUFACTURE

.1 Shop fabricate toilet partitions. Take site measurements for areas where partitions are to be located and fabricate to suit site dimensions.

.2 Fabricate doors, panels and pilasters from solid phenolic core material with high pressure matte plastic laminate surfaces fused to core. Edges shall be "black". Stiles and doors shall have a finished thickness of 19mm (3/4") thick. Panels shall be 13mm (1/2") thick.

.3 Check sizes and locations for washroom accessories and if necessary, reinforce panels.

.4 Prepare panels to accept tissue dispensers and grab bars where indicated on Drawings.

.5 Design supports to withstand, within acceptable deflection limitations, their own weight, the weight of the toilet partitions, loads imposed by the motion of partition doors and all live loads, which might be applied to the toilet partitions in the course of their normal function. Design supports as required to accommodate

structural deflection. Build in reinforcing to support the grab bars and withstand a downward pull of 227kg (500lbs). at any point on the grab bar. Provide additional stainless steel brackets as required to stabilize pilasters to Consultant's approval.

3 Execution

3.1 INSPECTION

.1 Check areas scheduled to receive partitions and urinal screens for correct dimensions, plumbness of walls and soundness of surfaces that would affect installation of holding brackets.

.2 Verify spacing of plumbing fixtures to assure compatibility with installation of partitions.

.3 Do not begin installation of partitions until conditions are satisfactory and agreement on details with the Owners or Contractors were well understood.

3.2 INSTALLATION

.1 Install partitions and urinal screens in strict accordance with Manufacturer's installation recommendations.

.2 Install partitions and urinal screens plumb, level and securely fastened in the locations shown on the Drawings.

.3 Perform drilling of steel, masonry and concrete necessary to install the work of this Section.

.4 Co-ordinate installation with the work of trades providing wall and floor finishes, washroom accessories and other adjacent partitions and constructions.

.5 Isolate contact surfaces to prevent electrolysis due to metal contact with masonry, concrete or dissimilar metal surfaces. Use bituminous paint, building paper, butyl tape or other approved means.

.6 Install hardware supplied under this Section and ensure that it is visually aligned.

.7 Securely install panels to walls and pilasters with fittings to make a strong and rigid installation.

.8 Locate wall channels so that holes for mounting occur in ceramic tile joints.

.9 Install urinal screens to locations on walls as indicated on Drawings, plumb, level and rigidly secured in place.

.10 Install partitions allowing the following clearances and tolerances:

- .1 Between panel edges and wall: 25mm +3mm (1" +1/8").
- .2 Between partition panel edge and pilaster panel: 13mm +3mm (1/2" +1/8").
- .3 Between pilaster panel edge and door edge: 5mm +1.5mm (3/16" +1/16"). Ensure that partitions are visually aligned from all viewpoints.

3.3 ADJUSTMENT

.1 Upon completion of the work or when directed, remove all traces of protective coating or paper, and polish compartments.

.2 Test hinges, locks and latches and where necessary, adjust and lubricate. Set hinges so that doors stand open 30° when compartment is not in use. Ensure that compartments are in working order.

3.4 CLEANING

.1 Clean and make good surfaces soiled or otherwise damaged in connection with the work of this Section. Replacing finishes or materials that cannot be satisfactorily cleaned.

.2 Upon completion of the work, remove all debris, equipment and excess material resulting from the work of this Section from the site.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 SUMMARY

.1 Furnish labour, materials and other services to complete the fabrication and installation of washroom accessories , including framed mirrors and attachment hardware.

.2 Include all materials and fitments required for the operation of any unit furnished, in the manner, direction and performance shown on the shop drawings and specified herein.

1.3 RELATED REQUIREMENTS

.1 Section 06 10 00
.2 Section 09 21 16
.3 Section 09 30 00

1.4 REFERENCES

.1 All references standards specified herein imply the latest edition of the standards.

.2 American Society for Testing and Materials (ASTM):
- .1 ASTM A153/A153M, Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- .2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 ASTM A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- .4 ASTM A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

1.5 SUBMITTALS

.1 Provide submittals specified and as required to assess conformance with the Contract Documents, in accordance with Section 01 33 00.

.2 Shop Drawings: Show and describe in detail, materials, finishes, dimensions, details of connections and fastenings, elevations, plans, sections, metal gauges, hardware and any other pertinent information.

.3 Coordinate the work of this Section with the placement of internal wall reinforcement.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location.

.2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

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

.4 Unsatisfactory materials shall be removed from the site.

.5 Adequately protect the structure and work of other Sections during delivery, storage, handling and execution of the work of the Section.

.6 Provide tools, plant and other equipment required for the proper execution of the work of this Section.

2 Products

2.1 MANUFACTURERS

.1 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; additional Manufacturers offering similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 33 00.

.2 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

.1 ASI Watrous - Global Partitions
.2 Bobrick
.3 Excel Dryer Inc.
.4 Cascades Pro

2.2 MATERIALS

.1 Provide one of the products indicated for each designation in the Washroom and Custodial Accessory Schedule below, subject to compliance with specified requirements.

.2 Stainless Steel: In accordance with ASTM A666, Type 304, with No. 4 finish (satin); minimum nominal thickness as established by product type.

.3 Sheet Steel: Steel: In accordance with ASTM A1008/A1008M, cold rolled, commercial quality; minimum nominal thickness as established by product type; surface preparation and metal pre-treatment as required for applied finish.

.4 Galvanized Steel Sheet: In accordance with ASTM A653/A653M, minimum Z180 coating designation.

.5 Galvanized Steel Mounting Devices: In accordance with ASTM A153/A153M, hot dip galvanized after fabrication.

.6 Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 FABRICATION

.1 Washroom and Custodial Accessories:
- .1 Surface Mounted:
  - .1 Fabricate units with tight seams and joints, and exposed edges rolled.
  - .2 Hang doors and access panels with continuous stainless steel hinge.
  - .3 Provide concealed anchorage where possible.
- .2 Recessed Mounted:
  - .1 Fabricate units of all welded construction, without mitred corners.
  - .2 Hang doors and access panels with full length, stainless steel hinge.
  - .3 Provide anchorage that is fully concealed when unit is closed.

.2 Workmanship shall be best grade of modern shop practice known to recognized Manufacturers specializing in this work. Joints and intersecting members shall be accurately fitted, made in true planes with adequate fastening. Wherever possible fastenings shall be concealed.

.3 Isolate where necessary to prevent electrolysis between dissimilar metal to metal or metal to masonry or concrete contact.

.4 Fabricate and erect work square, plumb, straight, true and accurately fitted. Provide adequate reinforcing and anchorage.

.5 Drilling shall be reamed and exposed edges left clean and smooth.

.6 Include anchors and fastenings necessary to anchor work of this Section.

.7 Coordinate with Section 06 10 00, for wood blocking for attachment of washroom accessories.

.8 Keys: Provide universal keys for internal access to accessories for servicing and re-supplying. Provide minimum of six keys to Owner's representative.

3 Execution

3.1 EXAMINATION

.1 Inspect surfaces over which the work of this Section is dependent for any irregularities detrimental to the application and performance of the work. Notify Consultant in writing of all conditions which are at variance with those in the Contract Documents and/or detrimental to the proper and timely installation of the work of this Section. The decision regarding corrective measures shall be obtained from the Consultant prior to proceeding with the affected work.

.2 Commencement of work of this Section implies acceptance of surfaces and conditions.

3.2 INSTALLATION

.1 Make thorough examination of Drawings and details, determine the intent, extent, materials, conditions of interfacing with other work and be fully cognizant of requirements.

.2 Work of this Section shall include complete installation of items specified herein. Installation shall be in strict accordance with Manufacturer's printed instructions.

.3 Securely fasten accessories, level and plumb in the locations shown on the Drawings and specified herein. All fastenings shall be concealed.

.4 Co-ordinate the work of this Section with the work of other Sections to provide the necessary recesses, edge conditions wood blocking for the accessories as required.

.5 Do all drilling of steel, masonry and concrete necessary for the anchorage of the work.

.6 Installed grab bars shall be capable of supporting a downward pull of 500lbs. per lineal foot.

3.3 ADJUSTING

.1 Check mechanisms, hinges, locks and latches, adjust and lubricate to ensure that accessories are in perfect working order.

3.4 CLEANING

.1 Upon completion of the work of this Section or when directed by Consultant, remove all protective coatings, and coverings. Clean and polish exposed surfaces.

3.5 WASHROOM AND CUSTODIAL ACCESSORY SCHEDULE

No.	Description / Model
CH	Coat Hooks: Satin finished stainless steel, square profiled robe hook with concealed mounting, provide two for each washroom, located as directed by Consultant: ASI 7340-S Bobrick B-76717
HD	Hand Dryer: High-speed hand dryer, surface mounted, touch free infrared activation. Motor: 208 V, 60 Hz.: Excel Dryer Inc. Xlerator hand dryer, finish to be later selected by Owner. Bobrick B-7125 InstaDry.
RPTD	Electronic Roll Paper Towel Dispenser: Surface mounted, battery operated, handicap accessible, capable of holding one 7.5” wide roll towel with 8” diameter and a 2.75” stub roll. Provide one set of batteries for each dispenser, if not already included from Manufacturer. Cascades Pro Tandem C350, dark gray with translucent blue accent.

MIR	Mirror (Flat): Framed, 910mm (36") high x 460mm (18") wide, fixed installation, mounted 1000mm (40") to bottom of frame: ASI 0600-1836 Bobrick B-290x1836
TPD	Toilet Tissue Dispenser: Double roll, surface mounted, tissue dispenser with concealed mounting, stainless steel construction, bright polished finish with theft resistant spindles: ASI 0040 Bobrick B-2892
SD	Wall-Mounted Soap Dispenser: Heavy-duty all-purpose valve, wall-mounted stainless steel soap dispenser, 1.2L capacity with visible viewing window or refill indicator: Bobrick B-818615 ASI 0345
JS	Janitor's Shelf complete with Mop and Broom Holders and Hooks: 864mm (34") long x 330mm (13") high x 200mm (8") deep. Shelf constructed of minimum 18-8 stainless steel, type 304, 18 gauge. Utility hooks fabricated of 11 gauge stainless steel, and mop holders fabricated of cadmium plated steel. Pivoting, spring-loaded serrated rubber cam shall hold round handles of 22mm to 32mm (7/8" to 1-1/4") diameter. ASI 1308-3 Bobrick B-239 x 34

END OF SECTION

1 General

1.1 SUMMARY

.1 Portable Fire Extinguishers

.2 Fire Extinguisher Cabinets

.3 Fire Extinguisher Brackets

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 FM - Factory Mutual System - Approval Guide.

.2 NFPA 10 - Portable Fire Extinguishers.

.3 ULC - Fire Protection Equipment Directory.

1.4 SUBMITTALS

.1 Submit shop drawings and product data for each of the following:
  .1 Portable fire extinguishers.
  .2 Cabinets.

1.5 QUALITY ASSURANCE

.1 Perform Work to NFPA 10.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years documented experience.

1.6 REGULATORY REQUIREMENTS

.1 ULC listed and labelled.

.2 Rated and identified in conformance with CAN/ULC S508, "Rating and Fire Testing of Fire Extinguishers".

2 Products

2.1 GENERAL

.1 Manufacturers
  .1 National Fire Equipment Ltd.
  .2 Wilson & Cousins
  .3 Badger Fire Protection
  .4 Kidde Fire Safety
  .5 Strike First

.2 All fire extinguishers shall be pressurized (stored pressure) rechargeable type, in accordance with NFPA 10, and ULC listed and labelled for the class of fires for which they are specified.

.3 Each extinguisher shall be complete with:
- .1 A Manufacturer's identification label indicating the extinguisher model number, rating, and operating instructions.
- .2 An anodized aluminum or chrome plated forged brass valve with positive squeeze grip on-off operation and a pull-pin safety lock.
- .3 Discharge hose with nozzle or horn and hose securing clip.

2.2 MULTI-PURPOSE DRY CHEMICAL (ABC)

.1 5lb (2.27kg)
- .1 Model No.: WBDL-ABC310LV.
- .2 ULC Rating: minimum 3A:10BC.

.2 10lb (4.54kg)
- .1 Model No.: WBDL-ABC10.
- .2 ULC Rating: minimum 6A:80BC.

2.3 CARBON DIOXIDE (BC)

.1 5lb (2.3kg)
- .1 Model No.: WBSF-5CO2.
- .2 ULC Rating: minimum 5BC.

.2 10lb (4.5kg)
- .1 Model No.: WBSF-10CO2.
- .2 ULC Rating: minimum 10BC.

2.4 CABINETS

.1 Fully Recessed
- .1 5lb (2.3kg) extinguisher.
  - .1 Recessed fire extinguisher cabinet, 8” x 17” x 5” (200mm x 425mm x 125mm), constructed of 22ga. (0.76mm) steel tub with a 16ga. (1.57mm) steel door and trim with a 1/4" (6mm) return frame, a full length semi concealed piano hinge and flush stainless steel door latch. Entire cabinet finished in backed enamel paint and glazed with 3/16” (5mm) clear glass.
  - .2 Model No.: 102F.
- .2 10lb (4.5kg) extinguisher.
  - .1 Recessed fire extinguisher cabinet, 10” x 30” x 8” (250mm x 750mm x 200mm), constructed of 18ga. (1.19mm) steel tub and 14ga. (2.0mm) steel door and trim with 1/2" (13mm) return frame, a full length semi-concealed piano hinge and flush stainless steel door latch. Front section to have a full 2" (51mm) adjustment to wall. Entire cabinet finished in baked enamel paint and glazed with 3/16" (5mm) clear glass.
  - .2 Model No.: CE-950-2.
- .3 Size: to accommodate specified extinguisher.

.2 Semi-Recessed
- .1 5lb (2.3kg) extinguisher.
  - .1 Semi-recessed fire extinguisher cabinet 8" x 17" x 5" (200mm x 425mm x 125mm), constructed of 22ga. (0.76mm) steel tub and

16ga. (1.57mm) steel door and trim with 1" (25mm) return frame, a full length semi-concealed piano hinge and flush stainless steel door latch. Entire cabinet finished in baked enamel paint and glazed with 3/16" (5mm) clear glass.

.2 Model No.: 102RS.

.2 10lb (4.5kg) extinguisher.

.1 Semi-recessed fire extinguisher cabinet 9" x 24" x 6" (225mm x 600mm x 150mm), constructed of 22ga. (0.76mm) steel tub and 16ga. (1.57mm) steel door & trim with 2" (51mm) return frame, a full length semi-concealed piano hinge and flush stainless steel door latch. Entire cabinet finished in baked enamel paint and glazed with 3/16" (5mm) clear glass.

.2 Model No.: CE-950-3-2.

.3 Size: to accommodate specified extinguisher.

2.5 WALL HOOKS AND BRACKETS

.1 Wall Hooks

.1 Type: DC 1-1/8”

.1 5lb (2.3kg) ABC and BC extinguisher: Model No. C160738.

.2 10lb (4.5kg) ABC and BC extinguisher: Model No. C160752.

.2 Type: CO_2

.1 5lb (2.3kg) BC extinguisher: Model No. SF5WH.

.2 10lb (4.5kg) BC extinguisher: Model No. SF1015WH.

.2 Brackets

.1 Standard Duty: 5lb (2.3kg) ABC extinguisher, Model No. UB5.

.2 Medium Duty: 10lb (4.5kg) ABC extinguisher, Model No. UP10-MD.

2.6 IDENTIFICATION

.1 Identify extinguishers in accordance with the recommendations of NFPA No. 10 and CAN/ULC-S508.

.2 Attach a tag or label to the extinguisher indicating the month and year of installation. Provide space for service dates.

3 Execution

3.1 INSTALLATION

.1 Install to Manufacturer's instructions.

.2 Conform to NFPA 10.

.3 Do not install extinguishers until after wall finishing work is complete. Contractor shall be responsible for all extinguishers until receipt of a Certificate of Substantial Performance of the Work.

.4 Locate and secure cabinets plumb and level. Establish top of cabinet (inside horizontal surface) 65" (1675mm) above finished floor.

.5 Fire extinguishers having a gross weight not exceeding 18.14kg (40lb) shall be installed so that the top of the fire extinguisher is not more than 1.5m (5.0ft) above the floor.

.6 In no case shall the clearance between the bottom of the fire extinguisher and the floor be less than 102mm (4”).

.7 Unless otherwise shown or specified, locate cabinets so that the centerline is approximately 1200mm (48") above the finished floor.

.8 Locate fire extinguisher in cabinet as indicated.

.9 Install with wall mounting bracket where not installed in cabinets.

3.2 APPLICATIONS

.1 Provide fire extinguishers where indicated and in conformance with the Ontario Fire Code and NFPA 10.

.2 Provide 10lb. (4.5kg) multi-purpose extinguishers in each fire hose cabinet and in mechanical rooms.

.3 Provide 10lb. (4.5kg) carbon dioxide extinguishers in electrical rooms, communications rooms and Data centres.

.4 Provide 5lb. (2.27kg) multi-purpose extinguishers in each kitchen/kitchenette.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 Contract Requirements and Division 01 apply to this Section.

1.2 SUMMARY

.1 This Section includes supply and installation of stainless steel countertops, integral sinks, and installation accessories.

1.3 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 05 50 00
.2 Section 06 10 00
.3 Section 06 40 23
.4 Section 07 92 00
.5 Section 09 21 16
.6 Division 22

1.4 QUALITY ASSURANCE

.1 Sub-Contractor executing work of this Section shall have a minimum 5 year continuous Canadian experience in successful manufacture/fabrication and installation of work type and quality specified. Submit proof of experience upon Consultant's request.

1.5 SUBMITTALS

.1 Submit submittals in accordance with the Contract Requirements and Section 01 33 00.

.2 Shop Drawings:
- .1 Submit shop drawings showing and describing details of opening sizes, configuration, clearances, materials, finishes, anchorage, components, and finishes.
- .2 Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
- .3 Show locations and sizes of cut outs and holes for plumbing fixtures, and other items installed in countertops.

.3 Product Data:
- .1 Provide copies of complete product data covering operation, adjustments and relevant maintenance data for incorporation into the Operation and Maintenance Manual.

1.6 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Construction Meetings: Arrange a meeting between Contractor, Sub-Contractor responsible for work of this Section, and Sub-Contractor responsible for fabrication of millwork framing and supports, other related work affected by work of this Section, and Consultant to coordinate and confirm layout of stainless

steel countertop and backsplash panels, installation of sinks and trims, and supporting structures before fabricating countertops.

1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate deliveries to comply with construction schedule and arrange for suitable storage (if required).

.2 Deliver and store products in manufacturer’s original packaging with identifying labels intact.

.3 Store products in dry, protected, off ground under cover location until required for installation. Store fabric shades in fabricator's original, undamaged containers.

1.8 SITE CONDITIONS

.1 Site Measurements: Verify dimensions of adjacent construction by site measurements before fabrication and indicate measurements on shop drawings where counters and sinks are indicated to fit to other construction:
- .1 Allow clearances.
- .2 Notify Consultant of discrepancies.
- .3 Coordinate fabrication schedule with construction progress to avoid delaying the Work.

.2 Established Dimensions: Establish dimensions and proceed with fabricating stainless steel countertops and sinks without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual site dimensions correspond to established dimensions; allow for trimming and fitting.

2 Products

2.1 APPROVED PRODUCTS AND MANUFACTURERS

.1 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products and provided the submit requests for substitution prior to the Inquiry Deadline, and in accordance with Section 01 33 00.

.2 Subject to compliance with requirements, Manufacturers and Fabricators offering stainless steel countertop and sinks that may be incorporated into the Work include, but are not limited to, the following:
- .1 Silver Star Metal Fabricating Inc.
- .2 Mott Manufacturing Inc.

2.2 MATERIALS

.1 Stainless steel: ASTM A167 type 304, with AISI No. 4 finish for exposed surfaces, 180 grit finish, free of buckles, pits, warps and imperfections.

.2 Fasteners: Type 304 stainless steel.

.3 Sound deadening material: Non-absorbent, hard drying, sound deadening compound for permanent adhesion to metal that does not chip, flake, or blister.
.1 Basis of Design Product: Aquaplas, Grade F-120A; Colour: Grey.

.4 Sealants: Refer to Section 07 92 00 for silicone sealants.

2.3 WORK SURFACES

.1 Provide work surfaces and ledges as indicated on the Drawings with required clips, screws and parts for fastening top to cabinet.

.2 Stainless Steel (SST) countertop: 1.519mm (0.0598") thick, type 304 stainless steel having satin #4 finish, with straight finished edges, backsplash as shown on Drawings, backed by wooden core as specified in Section 06 40 23.
.1 Backsplash formed from the same sheet as the top.
.2 Form tops having built-in sinks; coat underside of tops and sinks with plastic sound deadener.
.3 Welds shall be made without discoloration and shall be ground, polished, and passivated to blend harmoniously with the work surface finish.
.4 Form mechanical or field joints to tight butt joint to top surfaces, reinforced and held in alignment with steel reinforcements.
.5 Protect surfaces of the tops with strippable plastic coating to protect the tops during shipment and installation.

.3 Stainless Steel Sinks:
.1 On countertop by kitchen wall: Integrated welded 3-compartment sink with equal width compartments and nominal bowl depth of 178mm (7"), minimum 940mm (37") overall length x 480mm (19") overall width, to fit countertop space as shown on Drawings.
.2 On island countertop: Integrated welded 2-compartment sink with equal width compartments and nominal bowl depth of 178mm (7"), minimum 812mm (32") overall length x 480mm (19") overall width, to fit countertop space as shown on Drawings.
.3 Provide holes and cut-outs for plumbing and sanitary fixtures as indicated on the mechanical Drawings and Division 22.

2.4 FABRICATION

.1 Fabricate custom stainless steel countertop with specified edge style, complete with sink and backsplash to configuration and sizes shown.

.2 Fabricate top, sink and backsplash using largest practicable sheets of stainless steel to minimize number of seams.

.3 Seams, where required, shall be continuously welded, ground smooth and polished to blend with adjacent surfaces. Metal surface grain on adjoining sheets shall be aligned.

.4 Radius vertical and horizontal internal corners 19mm at sink. Slope sink drain table to drain.

.5 Provide stainless steel crumb cup with strainer basket.

.6 Provide stainless steel sink tail pipe suitable for drainpipe connection by Division 22.

.7 Cut out openings to match fixtures required and remove from countertops in the factory. No cutting of countertops and sinks is permitted on-site.

.8 Undercoat sink, drain board and countertop with sound deadening material.

3 Execution

3.1 EXAMINATION

.1 Verification of Existing Conditions:

.1 Carefully inspect the backup structure and millwork to verify that it is ready to accept the work of this Section.

.2 Verify all anchors, seats, connections attached to miscellaneous metal supports properly and securely fastened in correct locations.

3.2 INSTALLATION

.1 Support countertops evenly.

.2 Apply a thin bead of adhesive to top edges of base cabinet and set countertop, square to face of cabinet work.

.3 Coordinate work of this Section with work of other Sections.

.4 Secure and tighten connections with equal torque to prevent stress after units are properly aligned, vertically and horizontally with each other and with other related building components.

.5 Seal joints between countertops and adjacent materials with silicone sealant.

3.3 CLEANING AND PROTECTION

.1 Cleaning: Clean, patch and repair countertops and sinks with a non-abrasive cleanser to prevent scratches or marring of surfaces.

.2 Demonstration: Inform Owner of cleaning techniques and required cleansing materials.

.3 Protect stainless steel surfaces and corners liable to damage with wood blocking, sacking, or other means, to prevent damage of installed countertops until Substantial Performance.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 Section 20 01 00 applies to and governs the work of all Sections of Division 20, 21, 22, and 23.

.2 The technical Sections of this Division are generally divided into units of work for the purpose of ready reference. The division of the work among Sub-Contractors is not the Consultant's responsibility and the Consultant assumes no responsibility to act as an arbiter and/or to establish sub-contract limits between any Sections of the work.

.3 The Specifications are integral with the Drawings which accompany them. Neither shall be used alone. Any item or subject omitted from one but implied in the other is fully and properly required.

.4 Wherever differences occur in the Tender Documents, the most onerous condition governs. Base the bid on the costliest arrangement.

1.2 WORK INCLUDED

.1 Products and methods mentioned or shown in the Contract Documents complete with incidentals necessary for a complete operating installation. Provide all tools, equipment and services required to do the work.

.2 Cutting and patching of new or existing work.

.3 Excavating and backfilling.

.4 Identification of equipment, piping, ductwork, and valves and controllers.

.5 Concrete equipment bases, housekeeping pads, sump pits and trenches.

.6 Motors required for equipment supplied under this Division.

.7 Variable frequency drives for motors and equipment supplied under this Division.

.8 Internal wiring, relays, contactors, switches, transformers, motor starters, and all controls necessary for the intended operation, furnished with terminals and external controls suitable for connection to power source at a single easily accessed location for equipment items that are supplied with motors and/or electrical or electronic components under this Division.

.9 Disconnect switches for exhaust fans located on the roof complete with;
- .1 EEMAC/CSA type 1 enclosure if housed within a weatherproof cabinet,
- .2 EEMAC/CSA type 3 enclosure if exposed to weather.

.10 Refer to 20 95 00 Mechanical Electrical Coordination Schedule for extent of wiring and electrical characteristics.

.11 Verify the correct operation of each equipment item provided and/or altered and each system in total and obtain the Owner's approval prior to starting and/or returning to operation.

.12 Coordinate with all disciplines.

1.3 RELATED WORK

.1 Power wiring, conduit and connections for motors under this Division will be by Division 26.

.2 Power wiring, conduit and connections to variable frequency drives for motors under this Division will be by Division 26.

.3 Flashings for mechanical equipment and services located on or passing through roofs will be provided under Division 7. Supply counter flashings, and integral flashing collars on equipment and piping under this Division.

.4 Painting of exposed piping and ductwork other than for identification will be supplied under Division 09.

1.4 SUBMITTALS

.1 Submit names of the Commissioning Agent and Balancing Agent to Consultant within 1 week of award of Contract.

.2 Approval Drawings: Prepare and submit Drawings necessary for approval to any authority having jurisdiction and obtain two copies of approved Drawings for retention by the Consultant prior to commencement of work under this Division.

.3 Shop Drawings: Prepare and submit one electronic (PDF format) copy of shop drawings of major equipment items, to the Consultant for review. The Consultant will return one electronic copy, marked with comments and review stamp as deemed appropriate. Prepare the necessary number of copies of the returned set and distribute to the Owner, the Prime Consultant, the General Contractor, the site, and to Sub-Contractors and Suppliers.

- .1 Clearly indicate the Manufacturer's and Supplier's names, catalogue model numbers, details of construction, accurate dimensions, capacities and performance. Prior to submission check and certify as correct, shop drawings and data sheets. Do not order equipment until a copy of the shop drawings, reviewed by Consultant, has been returned to Contractor.
- .2 Clearly indicate the weight, location, method of support and anchor point forces and locations for each piece of equipment on shop drawings.
- .3 The Consultant will not review shop drawings that fail to bear the Contractor's stamp of approval or certification.
- .4 Read the following in conjunction with the wording on the shop drawing review stamp applied to each and every drawing submitted;
  " The consultant's review will be for conformity to the design concept and for general arrangement only and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the Contract Documents unless a deviation on the shop drawings has been approved in writing by the Consultant."

.4 Contractor's Material and Test Certificates: Prepare and submit certificates for each system installed. Where certificates are prescribed by regulations, codes or standards ensure they conform to the requirements of those documents (e.g., NFPA-standards). Include a copy of each certificate in the Operation and Maintenance manual. Certificates shall include the following:

- .1 description of the system (description and type),

.2 description of the tests conducted, and results observed, including re-testing, where necessary,
.3 description of any corrective measures undertaken,
.4 description of materials used (pipe and fittings),
.5 list of witnesses for each test conducted,
.6 date system left ready for service,
.7 signature of installing Contractor.

.5 Maintenance Data and Operating Instructions

.1 Submit one electronic (PDF format) copy of Operation and Maintenance Manual.

.2 Ensure the manuals contain the following information in a prominent location:
OPERATION & MAINTENANCE MANUAL
for
[Insert name of project]
[Insert date of submission]
[Insert Division Title]

.3 Provide a list of names, addresses and telephone numbers of equipment Suppliers, installing Contractors, General Contractors, Architect and Consultant. Include special telephone numbers for service departments on normal and emergency call basis.

.4 Provide descriptive literature (shop drawings) of each manufactured item. Include a bill of material with purchase order numbers and vendor's identification of equipment orders for each item.

.5 Include copies of start-up reports and checklists and all certificates issued with respect to this Contract.

.6 Ensure operating instructions include the following:

.1 General description of each mechanical system.
.2 Step by step procedure to follow in putting each piece of equipment into service.
.3 Schematic control diagrams for each separate mechanical system, control thermometers, freezestats, firestats, pressure gauges, automatic valves, and refrigeration accessories. Mark correct operating settings for each control device on these diagrams.
.4 Diagram of the electrical control system indicating the wiring of all related electrical components such as PE and EP switches, firestats, freezestats, fuses, interlocks, electrical switches and relays.
.5 Drawings of each control panel including temperature control and electrical panels, completely identifying all components on the panels and their function.

.7 Ensure maintenance instructions include the following:

.1 Manufacturer's maintenance instructions for each item of mechanical equipment installed under this Division. Instructions shall include installation instructions, parts numbers and lists, name of Supplier and maintenance and lubrication instructions.
.2 Summary list of each item of mechanical equipment requiring lubrication, indicating the name of the equipment item, location of

all points of lubrication, type of lubricant recommended, and frequency of lubrication.

.3 Equipment directory indicating name, model, serial number and nameplate data of each item of equipment supplied, and system with which it is associated.

.4 Balancing and testing reports.

.5 Copy of valve directory.

1.5 QUALITY ASSURANCE

.1 Conform to the minimum requirements or better of provincial and local codes, where existing, and to the requirements of local inspection authorities for execution of work under this Division.

.2 Ensure materials supplied under this Division conform to minimum requirements and recommendations or better of applicable standards of the following:

.1 AABC Associated Air Balance Council
.2 AMCA Air Moving and Conditioning Association
.3 ANSI American National Standards Institute
.4 ASA American Standards Association
.5 ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
.6 ASME American Society of Mechanical Engineers
.7 ASSE American Society of Sanitary Engineers
.8 ASPE American Society of Plumbing Engineers
.9 ASTM American Society of Testing and Materials
.10 AWWA American Water Works Association
.11 CAN2 National Standard of Canada (Published by CGSB)
.12 CAN3 National Standard of Canada (Published by CSA)
.13 CGSB Canadian General Standards Board
.14 CSA Canadian Standards Association
.15 EEMAC Electrical & Electronic Manufacturer's Association of Canada
.16 IEEE The Institute of Electrical and Electronics Engineers Inc.
.17 MSS Manufacturers' Standardization Society
.18 NBC National Building Code of Canada
.19 NEBB National Environmental Balancing Bureau
.20 NFPA National Fire Protection Association
.21 NEMA National Electrical Manufacturers Association
.22 OBC Ontario Building Code
.23 OFC Ontario Fire Code
.24 OFM Ontario Fire Marshall
.25 SMACNA Sheet Metal & Air Conditioning Contractors National Association
.26 TIAC Thermal Insulation Association of Canada
.27 TSSA Technical Standards and Safety Authority
.28 ULC Underwriter's Laboratories of Canada Ltd
.29 UL Underwriter's Laboratories (including cUL)

.3 Use latest editions and amendments in effect on date of Bid call subject to requirements of OBC.

.4 Arrange and pay for permits and inspections by authorities having jurisdiction, required in the undertaking of this Division. Make modifications required by authorities.

.5 All tradesmen employed on the project shall hold valid trade certificates/licenses and shall make a copy available for review by the Consultant and/or Owner when requested.

.6 All welding shall be executed by certified welders in accordance with registered procedures.

.7 All refrigeration work shall be executed only by mechanics with valid ODP cards.

1.6 PRODUCT DELIVERY, HANDLING AND STORAGE

.1 Immediately after letting of contract, review material and equipment requirements for this work, determine supply and delivery dates for all items, and notify Consultant of any potential delays in completion of this project in order that remedial action may be taken.

.2 Store neatly out of the way and protected from damage and theft, materials and equipment supplied under this Division that are received at the site by this Division.

1.7 JOB CONDITIONS

.1 Visit site and examine existing conditions which may affect work of this Division.

.2 Examine all Contract Documents to ensure that work of this Division may be satisfactorily completed.

.3 Notify Consultant upon discovery of conditions which adversely affect work of this Division. No allowance will be made after letting of Contract for any expenses incurred through failure to do so.

.4 Submission of a bid confirms that the Contract Documents and site conditions are accepted without qualifications, unless exceptions are specifically noted in the Bid.

1.8 WARRANTY

.1 Refer to General Conditions. Arrange with each Manufacturer/Supplier to extend warranties as necessary to coincide with warranty period or those periods specified.

.2 Make submissions necessary to register product warranties to the benefit of the Owner.

.3 Submit to Consultant, prior to Substantial Performance of the Contract, Manufacturer's written warranties covering periods longer than 1 year or offering greater benefits than required in Specifications and in the Owner's name.

1.9 DEFINITIONS

.1 The following are definitions of words found in this Specification and on associated Drawings under this Division:

.1 "Concealed" - hidden from normal sight in furred spaces, shafts, ceiling spaces, walls, and partitions.
.2 "Exposed" - mechanical work normally visible to building occupants.
.3 "Provide" - (and all tenses of "provide") - supply, install and connect complete.
.4 "Install" - (and all tenses of 'install") - install and connect complete, products and services specified.
.5 "Supply" - supply to site in location determined by Owner.
.6 "Wet" - wet areas requiring special materials.
.7 “Finished Area” – means any area or part of an area which receives a finish such as paint or is factory finished.

.2 Wherever the words “indicated”, “shown”, “noted”, “listed”, or similar words or phrases are used in the Specification they are understood, unless otherwise defined, to mean that the product referred to as “indicated”, “shown”, “listed”, or “noted” on the Drawings.

.3 Wherever the words “approved”, “satisfactory”, “as directed”, “submit”, “permitted”, “inspected” or similar words or phrases are used in the Specification they are understood, unless otherwise defined, to mean that Work or product referred to as “approved by”, “inspected by”, etc., the Consultant.

2 Products

2.1 MATERIALS AND EQUIPMENT

.1 Ensure materials and equipment provided under this Division are new and free from defects and bear labels of approval as required by codes referred to in this Division and/or by inspection authorities.

.2 Ensure apparatus and equipment provided under this Division bears Manufacturer's nameplate indicating name of Manufacturer, model number or type, size, capacity, CRN, and other pertinent information. Ensure nameplates are easily read and clearly visible, with openings provided where equipment is insulated.

.3 Ensure Manufacturers and Suppliers of equipment or materials under this Division determine if their products are composed of any hazardous materials. If they are, the products are suitably labelled and supplied with Safety Data sheets. Obtain the Owner's approval in writing to bring hazardous materials onto the site prior to doing so.

.4 When utilizing any products that are hazardous, keep Safety Data sheets on file at the job site and present them to anyone requesting this information. When transferring hazardous materials from original container into other containers, provide Workplace Labels on such containers.

2.2 ACCEPTABLE PRODUCTS

.1 First item named or specified by catalogue number meets Specifications regarding performance, quality of material and workmanship, and is acceptable to the Consultant.

.2 Items, other than first named, meeting Specifications regarding quality of materials and workmanship are acceptable to the Consultant, only, if they also meet performance and/or capacities specified and can be accommodated within the space allotted.

.3 General approval indicated by inclusion of other Manufacturers named is subject to final review of shop drawings, performance data and test reports. It is understood that any additional costs, and changes to associated or adjacent work resulting from provision of products supplied by a Manufacturer other than the first named is included in the Tender Price.

2.3 EQUIVALENTS AND ALTERNATIVES

.1 Suppliers wishing approval for additional equipment items as equivalent to those specified must submit a complete description, technical and performance data to Consultant by the Inquiry Deadline. Such equivalent equipment, if accepted, to conform to Specifications with regard to all details, accessories, modifications, features and performance. Deviations from Specifications must be stated in writing at time of submission for approval.

.2 Bid Prices shall include only products specified or approved equivalents. Contractors may propose unsolicited alternatives to the products specified. Alternative proposals shall be submitted in sealed envelope at time of general contract Bid submission and shall include full description and technical data, and a statement of the related increase or decrease in Bid Price should alternatives be accepted. All additional costs associated with unsolicited alternative proposals such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. Shall be included in the alternative price. Prior approval by Consultant is not required for unsolicited alternative proposals.

.3 Where the Contractor uses equipment other than that first named, on which the design is based, they shall be responsible for all details of installation including equipment size, arrangement, fit, and maintenance of all required clearances. Contractor shall prepare and submit revised layouts to indicate arrangement of all affected piping, ductwork, conduit, lighting, equipment, etc. Failure by Contractor to provide such Drawings will be considered indication that original arrangements and space allocations are adequate. All additional costs associated with equivalent equipment such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in Bid Price.

2.4 SUBSTIUTIONS DURING PROGRESS OF WORK

.1 If during the progress of work, specified products are not obtainable, equivalent or similar products by other Manufacturers may be permitted by the Consultant.

.2 Apply, in writing, to Consultant for substitution of any products, indicating the following:

- .1 Manufacturer's name, model number, details of construction, accurate dimensions, capacities and performance of proposed products.
- .2 Reason for substitution.
- .3 Any revisions to the contract price made necessary by substitution and shall include an itemized break down.

.4 Any revisions to the contract time made necessary by substitution.
.5 Any revisions to layout, arrangement or services made necessary by substitution.

.3 No substitutions will be permitted without written authorization from the Consultant.

2.5 CONSULTANT'S REVIEW

.1 The Consultant will review and evaluate unsolicited alternatives and substitutions proposed by the Contractor. Such review and evaluation work will be undertaken by the Consultant on an additional fee basis. The Contractor shall reimburse the Owner for all costs associated with such reviews and evaluations.

.2 The Contractor shall also reimburse the Owner for any and all costs incurred in updating Contract Documents to reflect such changes.

3 Execution

3.1 RELATIONSHIP WITH OTHER TRADES

.1 Cooperate with other trades whose work affects or is affected by work of this Division to ensure satisfactory installation and to avoid delays.

.2 Provide materials to be built-in, such as sleeves, anchors, and inserts, together with templates and/or measurements, promptly when required by other trades.

.3 Provide structural supports for equipment to be mounted on or in walls, supported above floors and/or suspended from the structure.

3.2 INSTALLATION REQUIREMENTS

.1 Install equipment neatly to the satisfaction of the Consultant. Unless noted otherwise install products and services to follow building planes. Ensure installation permits free use of space and maximum headroom.

.2 Confirm the exact location of outlets, fixtures and connections. Confirm location of outlets for equipment supplied under other Divisions.

.3 Install equipment and apparatus to allow free access for maintenance, adjustment and eventual replacement.

.4 Install metering and/or sensing devices to provide proper and reliable sampling of quantities being measured. Install instruments to permit easy observation.

.5 Provide suitable shielding and physical protection for devices.

.6 Install products and services in accordance with the Manufacturer's requirements and/or recommendations.

.7 Provide bases, supports, hangers and fasteners. Secure products and services so as not to impose undue stresses on the structure and systems.

.8 Do not use powder activated tools without written permission of the Consultant. Use them in accordance with the Owner's health and safety policies.

.9 Ensure that the load onto structures does not exceed the maximum loading indicated on the structural Drawings or as directed by the Consultant.

3.3 CONTRACT DRAWINGS

.1 The Drawings of this Division are performance Drawings and indicate general arrangement of the work. They are diagrammatic except where specific details are given.

.2 Obtain accurate dimensions from the architectural and structural Drawings, or by field measurement. Location and elevation of services are approximate. Verify them before construction is undertaken.

.3 Make changes, where required to accommodate structural conditions. Obtain Consultant's approval before proceeding.

.4 Adjust the location of materials and/or equipment as directed without adjustment to Contract Price, provided that the changes are requested before installation and do not affect material quantity. Outlets and/or equipment may be relocated up to 10’ (3m) in any direction without a change to the Contract Price.

.5 Note that the layout and orientation of the ceiling outlets on the architectural reflected ceiling plan Drawings may differ from that shown on the mechanical Drawings. Make the installation in accordance with the latest architectural reflected ceiling plans. Provide the equipment as specified and/or shown on the documents of this Division.

.6 The Drawings of this Division are intended for tender pricing. The quantities and quality to be included in the bid price shall be based on the layout and Specifications as indicated in the mechanical documents. If there is a difference in quantity between the architectural and Drawings of this Division, base the Contract Price on the greater quantity.

.7 Prepare installation Drawings to reflect the latest architectural ceiling layout.

3.4 RECORD DRAWINGS

.1 Maintain project "as-built" record drawings on site. The Consultant shall provide one electronic copy of Drawings in PDF format for Contractor use. Identify each set as "Project Record Copy".

.2 Record deviations from Contract Documents caused by site conditions or by addendums, site instructions and/or changes orders. Record deviations in red ink clearly and accurately, using industry standard drafting procedures consistent with quality and standards of Consultants documents.

.3 Record deviations as work progresses throughout the execution of this Contract. Maintain record Drawings on-site in clean, dry, legible condition, making them available for periodic review by the Consultant.

.4 Record the location of concealed services, particularly underground services. Before commencing any backfilling, obtain accurate measurements and information concerning correct location and depth of services.

.5 Transfer records from the "Project Record Copy" to electronic media storage device (i.e., DVD, USB Flash Drive) in AutoCAD format matching the Consultant's documents. Arrange computer file in layers to exactly match the layering system of the Consultant.

.6 Submit the "Project Record Copy" on one of electronic media with white prints of each drawing to the Consultant at the time of Substantial Performance.

3.5 USE OF EQUIPMENT

.1 For the duration of this Contract, do not use any piece of equipment provided under this Contract for the purposes of heating, ventilation or air conditioning without the specific authorization of the Owner and Consultant. Ensure the building is "broom clean" and painting is finished before asking permission for testing to commence.

.2 Specific written authorization shall be obtained for the use of equipment while work is still in progress, seal off ductwork, grilles, diffusers, and registers or other openings to the air distribution system(s) or air handling equipment that is not in use. Provide filters over openings in ductwork, grilles, diffusers and registers and in or at any air handling equipment that is in use. Ensure that the edges are sealed so that the filters are not bypassed. Change the filters frequently, to the satisfaction of the Consultant, until the building is turned over the Owner.

3.6 SPECIAL TOOLS & SPARE PARTS

.1 Within 30 days of award of Contract, prepare a complete itemized list of special tools and spare parts and submit to Consultant for review. The list shall be used as a checklist and should include provision for sign off by the Owner upon receipt.

.2 On completion of the project furnish spare parts to the Owner as follows and as indicated in each Section of these Specifications:
- .1 One glass for each gauge glass installed.
- .2 One set of v-belts for each piece of equipment.
- .3 One set of new filters for each filter bank installed.

.3 Identify spare parts containers as to contents and replacement parts number.

.4 Provide one set of special tools required to service equipment as recommended by Manufacturers.

.5 Furnish one grease gun and adaptors to suit different types of grease and fittings.

3.7 PAYMENT BREAKDOWN

.1 After award of the Contract, submit an itemized payment breakdown showing the installed cost with material and labour component breakdowns indicated separately for each of the major work items listed below. The payment breakdown shall be subject to the approval of the Consultant. No progress payment approvals will be processed until an approved payment schedule is in place.

.2 Payment breakdown shall be as follows:
- .1 General
  - .1 Mobilization and Insurance
  - .2 Project supervision
  - .3 Shop drawings

.4 Balancing and commissioning
.5 Project record drawings and manuals
.6 Instructions to Owner's personnel

.2 Plumbing and Drainage
.1 Underground and under floor piping
.2 Above ground piping
.3 Valves, specialties, roof and floor drains
.4 Gas piping
.5 Electronic trap priming manifolds
.6 Domestic water heaters
.7 Circulating pumps
.8 Plumbing fixtures, including emergency eye wash/shower stations
.9 Thermal Insulation

.3 Heating, Ventilating and Air Conditioning
.1 Ductwork
.2 Heat/Energy recovery units
.3 Heating equipment (boilers, electric heaters, etc.)
.4 Air conditioning equipment (air conditioning units)
.5 Packaged rooftop equipment
.6 Fans
.7 Grilles, diffusers, registers
.8 Terminal units (VAV boxes, Bypass boxes, Fan powered VAV boxes)
.9 Gas heating units (furnace and make-up air heaters)
.10 Vibration, noise control and Silencers
.11 Thermal Insulation
.12 Controls

.4 Fire Protection
.1 Project supervision
.2 Shop drawings complete with Hydraulic Calculations
.3 Fire sprinkler piping
.4 Sprinkler heads
.5 Valves
.6 Portable fire extinguishers
.7 Project record drawings and manuals

.3 Progress claims shall not be processed past 95% of the overall Mechanical Contract until the final commissioning has been completed. This will allow for sufficient deficiency holdbacks for problems identified during commissioning.

3.8 EXTRAS AND CREDITS

.1 Accompany all price submissions requested by Consultant for extra work, or work to be deleted, with a complete cost breakdown as follows:
.1 Materials, quantities and unit costs including any applicable Contractor’s trade discount clearly identified.
.2 Labour hours and unit costs.
.3 Total materials and labour costs.
.4 Overhead and profit mark-ups in accordance with the General Conditions of the Contract.

3.9 INSTRUCTIONS

.1 Instruct and familiarize the Owner's operating personnel with the various mechanical systems. Arrange instruction for each system separately.

.2 Provide instruction for each system on two separate occasions, coordinated with the Owner's staff operating schedule, in order that interested personnel may arrange to attend.

.3 Ensure each instruction period includes, but is not limited to the following;
- .1 Classroom seminar with operating manuals, product and system Drawings and such other audio/visual aids as may be appropriate,
- .2 Instruction during the classroom seminar by the Manufacturer's representative regarding the proper operating and maintenance procedures for each item of equipment,
- .3 Demonstration of the proper operating procedures for each item of equipment,
- .4 Explanation of the purpose and function of all safety devices provided, and
- .5 Demonstration of all measures required for safe and proper access for operation and maintenance.

.4 Provide a period of follow-up instruction approximately 1 month after completing the Owner's instruction to clarify and reinforce earlier instructions.

.5 Submit a letter from the Owner's management staff indicating the instruction has been given satisfactorily to the Consultant prior to Substantial Completion of the project.

3.10 COMMISSIONING

.1 The Contractor shall start-up and completely commission all equipment and systems installed and/or modified under this contract. Commissioning work shall be completed to the satisfaction of the Consultant prior to acceptance of the Work or any part thereof.

.2 The Contractor and his Sub-Contractors shall each assign an individual representing each of the relevant trades to the commissioning team and shall ensure that representatives of the equipment Manufacturers are present during the relevant commissioning tasks.

.3 The Contractor shall provide all necessary labour, materials, equipment, testing apparatus and incidentals necessary to completely start-up, verify, test and commission each system provided as part of the Work.

.4 Each Section shall prepare Check Sheets in accordance with the standards and shall issue them to the commissioning team for use during the commissioning process.

.5 One electronic copy in PDF format of the commissioning manuals. The manuals shall be personalized to indicate:
- .1 Name and logo of Facility,
- .2 Name of the project,
- .3 The Owner's project number,
- .4 Identification of the system commissioned,

.5 The date that the system was commissioned.

.6 Commissioning manuals shall include machine printable index dividers to organize each manual by system and by commissioning stage.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 Comply with the General Requirements of Section 20 01 00.

1.2 COMMON WORK RESULTS

.1 Section 20 05 00 applies to and governs all work of Division 21, 22, and 23.

1.3 REFERENCE STANDARDS

.1 Provide all work in accordance with requirements of Regulatory Agencies and conform to:
- .1 Local and district by-laws, regulations and published engineering standards.
- .2 The Ontario Building Code as amended.
- .3 The Ontario Gas Utilization Code as amended.
- .4 Regulations for Construction Projects under The Occupational Health and Safety Act.
- .5 Fire Code made under the Fire Marshal's Act.

.2 Conform to following CSA Standards:
- .1 CSA B242 Groove and Shoulder Type: Mechanical Pipe Couplings.
- .2 CSA B139 Installation Code for Oil-burning Equipment.
- .3 CSA B149.1 Natural Gas and Propane Installation Code.
- .4 CSA B64.10 Selection and Installation of Backflow Prevention Devices.
- .5 CSA B64.10.1 Maintenance and Field Testing of Backflow Prevention Devices.

.3 Conform to following National Research Council Canada publications:
- .1 National Building Code of Canada and Supplements to National Building Code of Canada.
- .2 National Fire Code of Canada.
- .3 Canadian Plumbing Code.

.4 The above documents or portions thereof are referenced within the work of Division 21, 22, and 23, and shall be considered part of the requirements of this document as though fully repeated herein.

2 Products

2.1 UNIONS, FLANGES AND DIELECTRIC COUPLINGS

.1 Cast brass, pressure, copper to copper unions shall be used with seamless copper tubing smaller than 3" (75mm).

.2 Cast brass flanges shall be used with seamless copper tubing, type L for tubing 3" (75mm) and larger.

.3 Dart type, 125lb. (860kPa) black malleable iron unions shall be used with all steel pipe for piping 2-1/2" (65mm) and smaller.

.4 Slip-on, 150lb. (1000kPa) carbon steel flanges with 1/16" (4mm) raised face shall be used with all steel pipe for piping larger than 2-1/2" (65mm).

.5 Gaskets for joining flanged steel pipe shall be 1/16" (4mm) Cranite ring type gaskets.

.6 Install approved dielectric coupling insulation at transition between dissimilar materials such as copper, brass, bronze, high alloy castings or stainless steel and low alloy ferrous materials such as black iron, steel, galvanized iron, or cast iron.

.7 Piping specialties including backflow preventers, strainers, valves etc. shall be line size unless indicated otherwise on Drawings.

2.2 ADHESIVES, SEALANTS, PAINTS AND COATINGS

.1 Adhesives, Sealants, Paints and Coatings: Use only low VOC emitting materials meeting following criteria;

- .1 Paint for Mechanical Identification: maximum VOC emission of 250 g/L
- .2 Touch-Up Paint: maximum VOC emission of 250 g/L
- .3 Zinc-Rich Primer: maximum VOC emission of 250 g/L
- .4 Adhesives for Mechanical Identification: maximum VOC emission of 70g/L
- .5 Sealants for service penetrations: maximum VOC emission of 650 g/L clear and 350 g/L pigmented
- .6 Sealants for Firestopping: max. VOC emission of 650 g/L clear and 350 g/L pigmented
- .7 Acrylic Sealant for supports and anchors: maximum VOC emission of 250 g/L
- .8 Insulation Vapour Barrier Lap Adhesive: maximum VOC emission of 80 g/L
- .9 Insulation Joint Sealer: maximum VOC emission of 250 g/L
- .10 Insulation Vapour Barrier Mastic: maximum VOC emission of 400 g/L
- .11 Flame Retardent Adhesive: maximum VOC emission of 650 g/L clear and 350 g/L pigmented

3 Execution

3.1 INSPECTION

.1 Inspect installed work of other trades and verify that such work is complete to point where work under this Division may properly commence.

.2 Verify that work of this Division may be executed in accordance with pertinent codes and regulations, Specifications, Drawings, and referenced standards.

.3 Review Drawings and verify dimensions at the site. Report discrepancies immediately to Consultant before proceeding with any construction work or shop drawings.

3.2 ABOVE GROUND PIPING INSTALLATION

.1 Cooperate with other trades whose work affects or is affected by work of this Section, to ensure satisfactory installation and to avoid delays. Provide all materials to be built-in such as sleeves, anchors, etc., together with accurate dimensions or templates, promptly.

.2 Layout all work accurately, installing piping parallel to lines of building.

.3 Install piping, wherever possible, in partitions and above ceiling. Do not install piping in outside walls unless so shown on Drawings. Wrap un-insulated piping in masonry walls with building paper.

.4 Install concealed piping close to building structure to minimize furring dimensions.

.5 Provide adequate space around piping to facilitate application of thermal insulation.

.6 Use dielectric couplings where piping of dissimilar metals connect.

.7 Where piping passes through concrete floors, or walls, sleeves shall be sized to permit the pipe to expand freely without binding or crushing pipe insulation.

.8 Where branch pipes are welded into main without the use of "T" connections, torch cut openings must be cut true, bevelled and filed smooth. Branch pipes must not be allowed to project inside of main pipe. Openings must not be cut large enough to permit entry of welding metal and slag within the pipe.

.9 Arrange all take-offs from mains to allow for expansion and contraction of pipes. Hot water branches serving down feed risers must be taken from lower sides or bottom of mains and grade down slightly to risers. Branches which serve units above the mains shall be taken from the top or sides of mains.

.10 Install automatic control valves and wells supplied under other Sections of this Division.

3.3 PIPING JOINTS

.1 Make joints in piping installed under this Division using persons familiar with the particular materials being used and in accordance with Canadian Plumbing Code, Manufacturer's instructions, and as specified herein.

.2 Use only welding and/or brazing operators, with a valid identification card, as issued under The Boiler and Pressure Vessels Act, to make joints in Registered Piping Systems, as indicated under Section 20 01 00.

.3 Use 95/5 Sb.Sn (tin-antimony) solder for joining copper drainage tubing smaller than 4" (100mm), and for joining copper water tubing installed above grade, and smaller than 4" (100mm).

.4 Use silver solder or Silfos for joining copper water tubing installed below grade, and all copper tubing 4" (100mm) and larger in size.

.5 Carefully ream joints in threaded pipe and paint with approved graphite type joint sealer on male connections only. Make connections with proper wrench to suit pipe size. Where leaks occur, the joint shall be disassembled and corrected if possible, or replaced. Over-tightening, caulking or peening will not be acceptable.

.6 Make joints in cast iron pipe with standard M-J joints in accordance with Manufacturer's recommendations and CSA B70-M86.

.7 Install unions or welding flanges at connections to valves, etc. to facilitate removal.

.8 Use butt welding and/or schedule 40 carbon steel welding fittings to join sections of steel piping with welding ends.

3.4 FLUSHING AND CLEANING

.1 Flush and sterilize domestic water mains in accordance with procedures established by AWWA Specification C601.

.2 Flush new domestic water piping in accordance with Local and Provincial Codes.

.3 Thoroughly flush all other piping installed by this Division.

.4 Remove, clean and replace all strainers in systems after flushing.

.5 Thoroughly clean all equipment and fixtures, lubricate mechanical equipment, and leave all items in perfect order ready for operation.

3.5 PIPING SYSTEMS TESTING AND INSPECTION

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

.2 Test all piping at the completion of roughing-in and prior to concealment, insulation or covering of piping.

.3 Make tests, which are required by any authority having jurisdiction, in the presence of the authority's authorized inspector and shall be certified by them.

.4 Conduct tests in the presence of:
- .1 Authorized inspector(s) for authorities having jurisdiction
- .2 The Owner's Representative
- .3 The Consultant

.5 Notification must be given at least 48 hours in advance of tests being conducted, to all persons required to be present.

.6 Repair all leaks exposed during testing and retest. If defects in pipe or fittings are discovered in the system, they shall be removed and replaced.

.7 Certify tests: not required by authorities having jurisdiction.

3.6 EQUIPMENT TESTING AND INSPECTION

.1 Test operation of equipment installed under this Division according to instructions in appropriate articles of this Division. Make any required adjustments or replacements to ensure equipment is operating as intended. Retest equipment requiring adjustment or replacement.

.2 Pay all fuel consumption charges for equipment under testing and during commissioning.

.3 Conduct tests before application of external thermal insulation and before concealment of piping or ductwork.

.4 Arrange and pay for inspections by authorities as required by code and complete any changes or alterations required by such inspections.

.5 Conduct tests in the presence of:
- .1 Authorized inspector(s) for authorities having jurisdiction.

.2 The Systems Verification Agency.
.3 The Consultant.
.4 The Owner's Representative.

.6 Notification must be given at least 48 hours in advance of tests being conducted, to all persons required to be present.

3.7 TESTING AND BALANCING

.1 Allow sufficient time for testing and verification prior to Substantial Completion. Notify Testing and Balancing Agency on completion of adjusting and balancing of systems.

.2 Adjust systems and components (drives, sheaves, belts, etc.) as required by Testing and Balancing Agency.

.3 Maintain systems in full operation during testing and verification.

.4 Make adjustments to control systems as required, to facilitate verification. Maintain all safety controls in operation.

.5 Check and correct alignment of V-belts, drive shaft coupling drives, etc. as required by Testing and Balancing Agency.

.6 Provide pitot tube test fittings at all main branches of sheet metal work and at intake and discharge locations of air handling systems as required by Testing and Balancing Agency.

3.8 ELECTRICAL COMPONENTS AND WIRING

.1 Conform to requirements of Division 26, 27 and 28 for all wiring included in Division 21, 22, and 23. Includes pre-wired equipment provided by Sections under Division 21, 22, and 23.

.2 Ensure that all pre-wired electrical equipment is CSA approved. Arrange and pay for special approval where this is not possible.

.3 Coordinate all wiring requirements with other Divisions. Line voltage wiring from power distribution panels to starters and from starters to motors will be provided under Division 26. All the field wiring for equipment shall be included under Division 21, 22, and 23, unless specifically called for under Division 26.

3.9 PROTECTION

.1 Protect finished and unfinished work by tarpaulins, or other covering(s), from damage due to execution of work under this Division.

.2 Repair to satisfaction of Consultant, damage to building resulting from failure to provide such protection.

.3 All existing air intake and exhaust openings that may be affected by dust and/or debris from the construction work shall be fitted with appropriate filter media to protect against entry of dust and/or debris into the building and its air distribution systems. Filters shall be closely monitored and replaced when necessary. The Contractor shall replace existing filters that become contaminated with dust and/or debris from construction work with new filters.

.4 In the event that dust and debris from construction work does penetrate the building and/or its air distribution systems, the Contractor shall be responsible for cleaning the affected areas and/or systems.

.5 Temporary filters shall be removed on completion of the construction works.

3.10 CUTTING AND PATCHING

.1 Include cutting and patching as required in execution of work under respective Sections of this Division.

.2 Holes through the structure will not be permitted without written approval of the Consultant. Any and all openings required through the completed structure must be clearly and accurately shown on a copy of the relevant structural Drawing(s). Exact locations, elevations and size of the proposed opening must be identified well in advance of the need for the work.

.3 All sleeved or formed openings through the structure must be shown on sleeving Drawings and must be approved by the Structural Consultant prior to construction.

.4 The Contractor shall conduct exploratory work including x-ray of the existing structure, shall mark the location of embedded reinforcements, anchors, conduits and piping on exposed surfaces of adjacent floors and/or walls and shall pay all associated costs.

.5 Reinforcing shall not be cut or modified without prior approval of the Structural Consultant. Should re-enforcement be cut without such prior approval, the cost of any additional re-enforcement deemed necessary by the Structural Consultant shall be the responsibility of this Contractor.

.6 Alternative imaging techniques are subject to the approval of the Structural Consultant.

.7 Ensure that cutting and patching of roofs and reinforced concrete structures is executed by specialists familiar with the materials affected and is performed in a manner to neither damage nor endanger the work. Coordinate and supervise such cutting and patching.

.8 Maintain the integrity of fire rated assemblies where they are pierced by ducts and pipes.

.9 Make good surfaces affected by this work and repair finish to satisfaction of Consultant. Finish painting, where required, will be provided under Division 09.

3.11 EXCAVATING AND BACKFILLING

.1 Be responsible for excavation and backfilling necessary for installation of underground work under this Division.

.2 Excavate to the depth and dimensions shown on Drawings.

.3 Keep excavation free of water by bailing, pumping or a system of drainage as required.

.4 Cut and trim banks of excavation evenly, as nearly vertical as possible, and shore if required to prevent caving-in.

.5 Keep bottom of excavation clean and clear of loose material. Slope or grade as required.

.6 Provide shoring in accordance with The Occupational Health and Safety Act, and Regulations for Construction Projects.

.7 Notify the Consultant immediately in case of encountering any unstable ground, unsuitable for bearing of pipes. Consultant will decide the method of installation of pipes in unstable ground.

.8 Inform the Consultant immediately if the excavation reveals seepage zones, springs or other unexpected sub-surface conditions which may necessitate revisions to drainage or water supply systems.

.9 Obtain Consultant's approval prior to commencement of backfilling of trenches. Backfill the trenches carefully to prevent injury to the work and subsequent settlement and execute backfilling generally as follows:

- .1 Provide minimum 6" (150mm) fine gravel or coarse sand bedding (Class B) or as indicated for the bottom of trenches.
- .2 Backfill above pipe bedding with granular material specified, hand tamp in layers of 6" (150mm) thickness. Extend backfill 12" (300mm) above pipe.
- .3 Backfill and consolidate remainder of trench depth below paved or gravelled areas with granular Class "B" aggregate in 6" (150mm) layers to an elevation to allow for thickness of Class "A" aggregate and asphalt pavement.
- .4 Backfill and consolidate reminder of trench depth below sodded or seeded areas with specified granular material or material obtained from site excavation where approved by Consultant, in 9" (225mm) layers to an elevation 6" (150mm) below of proposed grades in sodded/seeded areas.
- .5 Compact each layer thoroughly at optimum moisture content with approved hand or mechanical tampers to a density equal to;
  - .1 95% of Maximum Standard Proctor Density
    - .1 Behind foundation and retaining walls on grades
    - .2 Below sodded or seeded areas
  - .2 100% of Maximum Standard Proctor Density
    - .1 Below slabs on grade within building areas up to the underside of the crushed stone underlay
    - .2 Below paved or gravelled areas
- .6 Do not puddle or flood with water for consolidating backfill. Add water during the compaction to optimum moisture content of backfilling material.

3.12 SUPPORT AND ATTACHMENT

.1 Support and attach piping, ductwork, fixtures and equipment from load bearing structures such as beams, joists, reinforced concrete slabs and concrete block walls, and do not support from or attach to steel roof deck and/or wall or ceiling finishes. Roof mounted mechanical equipment and services shall be anchored to the roof structure to resist both lateral and uplift wind forces in accordance with requirements of the Ontario Building Code.

3.13 PAINTING

.1 Repair minor damage to finish of equipment with standard factory applied baked enamel finish under the appropriate Sections. Replace entirely, items suffering major damage to finish if too extensive to be repaired in the opinion of the Consultant.

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

3.14 DISSIMILAR METALS

.1 Separate dissimilar metals in order to prevent galvanic corrosion.

.2 Provide gaskets or shims of approved materials to avoid electrolytic action.

.3 Use dielectric unions and/or flanges where piping of dissimilar metals are connected.

3.15 EQUIPMENT BASES AND CURBS

.1 Supply and erect structural work required for installation of mechanical equipment.

.2 Build concrete bases 4" (100mm) high, providing all necessary inserts, anchor bolts and other fasteners required, for floor mounted tanks, heaters, pumps, air handlers, boilers, etc. Make concrete bases 2" (50mm) larger all around than the base of the supported equipment and trowel finish to a neat smooth finish. Anchor equipment to pads using 8" (200mm) cast-in-place anchor bolts. Ensure concrete supplied under this Division is 2500psi (17 MPa) compressive strength after 28 days.

.3 Build 4" (100mm) high concrete curbs around all openings through floors for ductwork. Make allowances for installation of ductwork and fire dampers where required. Ensure joint between curb and floor is watertight and maintains integrity of floor membrane where applicable.

3.16 SERVICE CONNECTIONS

.1 Include in Bid Price all amounts required by municipality and/or utilities for service connections and /or modifications to service connections for water services. Ensure amounts include fees, assessments, charges, etc., required in relation to service connection. Do not include acreage or frontage charges.

3.17 BELT DRIVES AND SHEAVES

.1 Provide belt driven equipment with V-belt drive, designed for at least 130% of motor nameplate horsepower rating and in accordance with Manufacturer's recommendations for type of service intended. Ensure belt drives are at least 95% efficient. Balance and properly align drives. Provide matched sets of belts for multiple belt assemblies. Select belts to suit starting torque of drive. Do not use single belt drives for motors larger than two horsepower.

.2 Provide motor sheaves for one and two belt drives of variable pitch type, with Dodge key adjustments. Supply two sets of fixed drive sheaves for drives with three or more belts. Install first set of fixed motor sheaves to obtain the originally

specified RPM. After initial test and preliminary adjustment, supply and install the second set of fixed sheaves if necessary, to provide the design flow quantities as established on the job. Obtain correct total flow rate for fans through speed changes and not by throttling.

.3 Provide adjustable sheaves on motor sizes up to 2 HP (1492 W) and fixed sheaves on larger motors.

3.18 FIELD QUALITY CONTROL

.1 Temporary and Trial Usage
- .1 Allow the Owner the privilege of temporary and trial usage of installed equipment, as soon as work is complete, for a period of time required to conduct a thorough test.
- .2 Do not construe such usage as evidence of acceptance of work by Owner.
- .3 Repair damage to work tested, resulting from such trial usage, by this Contractor at no cost to Owner.

.2 Systems Verification:
- .1 Verify the correct installation and proper operation of equipment and systems installed. Adjust and balance each system as necessary to achieve optimum operation of each system.
- .2 Co-operate with the Systems Verification agency as follows:
  - .1 Provide assistance when and as requested,
  - .2 Co-ordinate completion of work systematically to permit orderly verification and adherence to schedules,
  - .3 Provide additional necessary flow balancing devices as directed by agency,
  - .4 Notify the Systems Verification Agency of tests being conducted.

3.19 ADJUST AND CLEAN

.1 Clean equipment and fixtures, lubricate mechanical equipment installed under this Division and leave items in perfect order ready for operation.

.2 Test and adjust control devices, instrumentation, relief valves, dampers, etc., installed in this Division after cleaning of systems and leave in perfect order ready for operation.

.3 Remove from the premises upon completion of work of this division, debris, surplus, and waste materials resulting from operations.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Comply with the General Requirements of Section 20 01 00 and the Common Work Elements of Section 20 05 00.

.2 Read and conform to:
- .1 The Contract CCDC 2, Stipulated Price Contract as amended in the Contract Documents;
- .2 Division 01 requirements and documents referred to therein.

1.2 SECTION INCLUDES

.1 Variable Frequency Drives (VFD's).

1.3 SUBMITTALS

.1 Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

.2 Manufacturer's Installation Instructions: indicate setting, mechanical connections, lubrication, and wiring instructions.

.3 Submit Manufacturer's performance data including dimensional drawings, power circuit diagrams, installation and maintenance manuals, warranty description, VFD's full load amperage (FLA) rating, certification agency file numbers and catalogue information.

.4 The Specification lists the minimum VFD performance requirements for this project. Each supplier shall list any exceptions to the Specification. If no departures from this Specification are identified, the supplier shall be bound by the Specification.

.5 Harmonic filtering: The Vendor shall, with the aid of the buyer's electrical power single line diagram, providing the data required by IEEE-519, perform an analysis to initially demonstrate the supplied equipment will meet the IEEE standards after installation. If, as a result of the analysis, it is determined that additional filter equipment is required to meet the IEEE 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 IEEE-519 voltage and current distortion limits as shown in table 10.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or primary side of the main distribution transformer.

1.4 QUALITY ASSURANCE

.1 Conform to Ontario Electrical Safety Code.

.2 Provide certificate of compliance from authority having jurisdiction indicating approval of variable frequency drives.

.3 All optional features shall be functionally tested at the factory for proper operation.

1.5 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by CSA or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE AND PROTECTION

.1 Protect variable frequency drives stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering.

1.7 WARRANTY

.1 Provide extended coverage 5 year warranty for variable frequency drives.

.2 The warranty shall include parts, labour, travel costs and living expenses incurred by the Manufacturer to provide factory authorized on-site service.

2 Products

2.1 MANUFACTURER

.1 Provide Danfoss Graham VLT FC102 Variable Frequency Drives.

.2 Acceptable alternates, subject to shop drawing review.
- .1 ABB
- .2 Eaton / Cutler Hammer

2.2 VARIABLE FREQUENCY DRIVES

.1 Furnish complete VFDs 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 VFD enclosure, unless otherwise specified. VFD’s shall be housed in a metal NEMA enclosures rated for the environment the drive shall be located. The VFD's UL listing shall allow mounting in plenum or other air handling compartments. The drive efficiency shall be 96% or better at full speed and load.

.2 The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC 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 eliminate the need for motor de-rating.

.3 With the motor's rated voltage applied to the VFD input, the VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VFD’s utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.

.4 The VFD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.

.5 The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD, including all specified options, shall be assembled by the Manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Assembly of the option panels by a third-party panel shop is not acceptable. The appropriate CSA or C-UL stickers shall be applied to both the VFD and option panel, in the case where these are not contained in one panel. Both VFD and option panel shall be manufactured in ISO 9001 certified facilities.

.6 The VFD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFDs without DC link reactors shall provide a minimum 3% impedance line reactor.

.7 The VFD's full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.

.8 The VFD shall be able to provide full torque at any selected frequency from 28Hz to base speed to allow driving direct drive fans without de-rating.

.9 An automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.

.10 Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.

.11 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 de-couple the motor from the load to run the test.

.12 Galvanic and/or optical isolation shall be provided between the VFD'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. VFDs not including either galvanic or optical isolation on both analogue I/O and discrete I/O shall include additional isolation modules.

.13 VFD power components to be designed for 575 VAC. Components designed for 480 VAC are not acceptable.

.14 VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.

.15 VFD's operating motors not designed to meet NEMA MG1 Part 31 should include Output Load reactors.

2.3 PROTECTIVE FEATURES

.1 A minimum of Class 20 I^2t 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 AC line phase, output short circuit, output ground fault, over-voltage, under-voltage, VFD over-temperature and motor over-temperature. The VFD shall display all faults in plain English. Codes are not acceptable.

.3 Protect VFD from sustained power or phase loss. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal.

.4 The VFD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.

.5 To prevent breakdown of the motor winding insulation, the VFD shall be designed to comply with IEC Part 34-17. Motors shall have inverter rated insulation (1600 V).

.6 VFD shall include a "signal loss detection" circuit to sense the loss of an analogue input signal such as 4 to 20 mA or 2 to 10VDC and shall be programmable to react as desired in such an instance.

.7 VFD shall function normally when the keypad is removed while the VFD is running and continue to follow remote commands. No warnings or alarms shall be issued as a result of removing the keypad.

.8 VFD shall catch a rotating motor operating forward or reverse up to full speed.

.9 VFD shall be rated for 100,000 amp interrupting capacity (AIC).

.10 VFD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.

.11 VFD shall continue to operate without faulting until input voltage reaches 300 VAC on 208/230-volt VFDs, 539 VAC on 460-volt VFDs, and 701 VAC on 575-volt VFDs.

2.4 INTERFACE FEATURES

.1 Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference.

.2 The VFD shall be able to be programmed to provide a 24 VDC output signal to indicate that the VFD is in Auto/Remote mode.

.3 The VFD shall provide digital manual speed control. Potentiometers are not acceptable.

.4 Lockable, alphanumeric backlit display keypad can be remotely mounted up to 10’ (3m) away using standard 9-pin cable.

.5 The keypads for all sizes of VFDs shall be identical and interchangeable.

.6 To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFD's keypad, place that keypad on all other VFD’s in turn and download the setup parameters to each VFD. To facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters.

.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 VFD when the keypad is removed.

.10 A quick setup menu with factory pre-set typical HVAC parameters shall be provided on the VFD eliminating the need for macros.

.11 The VFD shall include a standard RS-485 communications port and capabilities to be connected at a future date to a Johnson Controls N2, Siemens FLN, or Lonworks. The connection shall be software selectable by the user.

.12 As a minimum, the following points shall be controlled and/or accessible:

.1 VFD Start/Stop, Speed reference, Fault diagnostics, and Meter points as follows;

.2 Motor power in HP, Motor power in kW, Motor kW-hr, Motor current, Motor voltage, Hours run, Feedback signal #1, Feedback signal #2, DC link voltage, Thermal load on motor, and Thermal load on VFD, heat sink temperature.

.13 Four additional Form C 230-volt programmable relays shall be available for factory or field installation within the VFD.

.14 Two set-point control interface (PID control) shall be standard in the unit. VFD shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.

.15 Floating point control interface shall be provided to increase/decrease speed in response to contact closures.

.16 Four simultaneous displays shall be available. They shall include frequency or speed, run time, output amps and output power. VFDs unable to show these four displays simultaneously shall provide panel meters.

.17 Sleep mode shall be provided to automatically stop the VFD when its speed drops below set "sleep" level for a specified time. The VFD shall automatically restart when the speed command exceeds the set "wake" level.

.18 The sleep mode shall be functional in both follower mode and PID mode.

.19 Run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD 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 VFD to start.

.20 The following displays shall be accessible from the control panel in actual units: Reference Signal Value in actual units, Output Frequency in Hz or percent, Output Amps, Motor HP, Motor kW, kWhr, Output Voltage, DC Bus Voltage, VFD Temperature in degrees, and Motor Speed in engineering units per application (in GPM, CFM, etc.). VFD will read out the selected engineering unit either in a

linear, square or cubed relationship to output frequency as appropriate to the unit chosen.

.21 The display shall be programmed to read in pascals (Pa) for an air handler application, kilopascals (kPa) for a pump application, and temperature Celsius (°C) for a cooling tower application.

.22 VFD's shall be able to be programmed to sense the loss of load and signal a no load/broken belt warning or fault.

.23 If the temperature of the VFD's heat sink rises to 176°F (80°C), the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VFD shall automatically reduce its output frequency to the motor. As the VFD's heat sink temperature returns to normal, the VFD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.

.24 The VFD shall have temperature-controlled cooling fans for quiet operation and minimized losses.

.25 The VFD shall store in memory the last 10 faults and related operational data.

.26 Eight programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.

.27 Two programmable relay outputs, one Form C 240 VAC, one Form A 30 VAC, shall be provided for remote indication of VFD status.

.28 Three programmable analogue inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include two voltage (0 to 10 VDC, 2 to 10 VDC) and one current (0 to 20 mA, 4 to 20 mA) input.

.29 Two programmable 0 to 20mA analogue outputs shall be provided for indication of VFD status. These outputs shall be programmable for output speed, frequency, current and power. They shall also be programmable to provide a selected 24VDC status indication.

.30 Under fire mode conditions, the VFD shall be able to be programmed to automatically default to a pre-set speed.

2.5 ADJUSTMENTS

.1 VFD shall have an adjustable carrier frequency in steps of not less than 0.1kHz to allow tuning the VFD to the motor.

.2 Sixteen pre-set speeds shall be provided.

.3 Four acceleration and four deceleration ramps shall be provided. Acceleration and deceleration time shall be adjustable over the range from 0 to 3,600 seconds to base speed. The shape of these curves shall be automatically contoured to ensure no-trip acceleration and deceleration.

.4 Four current limit settings shall be provided.

.5 If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: under voltage, overvoltage, current limit and inverter overload.

.6 The number of restart attempts shall be selectable from 0 through 20 or infinitely 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.

2.6 BYPASS

.1 Provide a manual 3-contactor bypass, were indicated in schedules, consisting of a door interlocked main fused disconnect pad lockable in the off position, a built-in motor starter and a four position DRIVE/OFF/BYPASS/TEST switch controlling three contactors. In the DRIVE position, the motor is operated at an adjustable speed from the VFD. In the OFF position, the motor and VFD are disconnected. In the BYPASS position, the motor is operated at full speed from the AC power line and power is disconnected from the VFD so that service can be performed. In the TEST position, the motor is operated at full speed from the AC line power while power is applied to the input of the VFD. This allows the VFD to be given an operational test while continuing to run the motor at full speed in bypass. In case of an external safety fault, a customer supplied normally closed dry contact shall be able to stop the motor whether in DRIVE or BYPASS mode.

.2 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.

2.7 SERVICE CONDITIONS

.1 Ambient temperature, 14°F to 104°F (-10°C to 40°C).

.2 0 to 95% relative humidity, non-condensing.

.3 Elevation to 3,300’ (1,006m) without de-rating.

.4 AC line voltage variation, -10 to +10% 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.

3 Execution

3.1 START UP SERVICE

.1 The Manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.

3.2 EXAMINATION

.1 Contractor to verify that job site conditions for installation, meet factory recommended and code required conditions for VFD 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 VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.

END OF SECTION

1 General

1.1 SUMMARY

.1 Thermometers.
.2 Pressure Gauges.
.3 Water Meters.

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 ASME B40.100 - Pressure Gauges and Gauge Attachments.
.2 ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.
.3 ASTM E1 - Specification for ASTM Thermometers.
.4 ASTM E77 - Inspection and Verification of Thermometers.
.5 AWWA C700 - Cold Water Meters - Displacement Type, Bronze Main Case.
.6 AWWA C701 - Cold Water Meters - Turbine Type, for Customer Service.
.7 AWWA C702 - Cold Water Meters - Compound Type.
.8 AWWA C706 - Direct-Reading, Remote Registration System for Cold-Water Meters.
.9 AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.
.10 ISA RP 3.2 - Flange Mounted Sharp Edged Orifice Plates for Flow Measurement.
.11 UL 393 - Indicating Pressure Gauges for Fire-Protection Services.
.12 UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.
.13 Refer to the latest edition of the above noted items.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 20 01 00 for the following items:
  .1 Thermometers,
  .2 Pressure gauges,
  .3 Water meters.

2 Products

2.1 THERMOMETERS

.1 Thermometers for use in pipelines, shall be Trerice model BX9-1-403 heavy duty industrial type with dual scale range (metric and imperial), adjustable angle separable sockets connections, cast aluminum case finished in dull black baked enamel, glass front with chrome plated frame, 225mm (9") long scale and red reading mercury. Range of scale, unless otherwise specified shall be from approximately 20% below minimum to 20% above maximum temperature encountered. Thermometers shall have extension necks and extended stems.

.2 Thermometers located over 2.7m (9') above floor shall be remote mounted dial type Trerice model L-80341 with 115mm (4-1/2") stainless steel case back

flange, liquid filled, bottom outlet, connecting tubing, brass movement, bronze bearings, stainless steel pointer, glass window and white background and black markings and be mounted on a steel or aluminum plate at eye level. Remote bulb shall be brass for piping and coiled copper for ductwork.

.3 Acceptable Manufacturers, subject to shop drawing review: Ashcroft, U. S. Gauge, Weiss Instruments, Winter's Thermogauges Ltd.

.4 Thermometer scale ranges shall be as follows:

Combination Systems	Scale Range
Domestic hot water	0°C to 82°C (30°F to 180°F)

2.2 PRESSURE GAUGES

.1 Pressure gauges shall be Trerice model 600CB with 115mm (4-1/2") diameter black finished cast aluminum case, brass socket, phosphor bronze bourdon tube, bronze movement glass window, and suitably sized Trerice model 872 snubber. Bourdon tube shall be silver brazed at socket and at linkage. Dial shall be white finish with black figures and graduations, mounted on movement assembly independent of gauge casing. Scales shall be combined (metric/Imperial). Operating pressure indication shall fall in middle 1/3 of scale range, if scale range is not otherwise indicated. Install a Schedule 80 seamless steel siphon in line to gauges on steam service. Gauges shall be 115mm (4-1/2") diameter unless specified otherwise.

.2 Acceptable Manufacturers, subject to shop drawing review: Ashcroft, U. S. Gauge, Weiss Instruments, Winter's Thermogauges Ltd.

2.3 WATER METERS

.1 Water meters shall be in accordance with the local authorities' requirements and as follows:

.1 Size 2" (50mm) and smaller: Neptune Trident T-10, certified to NSF/ANSI 61, Annex G and F, for cold water measurement with a maximum working pressure of 150 psi (1,034 kPa) and a maximum operating temperature of 80°F (26.7°C). The measuring chamber shall include a nutating disc design made from a synthetic polymer.

.2 Size 2-1/2" (65mm) and larger: Neptune Tru/Flo, for cold water measurement with a working pressure of 150 psi (1,034 kPa) and a maximum operating temperature of 80°F (26.7°C). The register shall be a direct reading, centre sweep, roll sealed, magnetic drive with a low-flow indicator. The measuring element shall be AWWA Class II turbine, hydrodynamically balanced rotor with a nutating disc.

.2 Remote readout head shall be with attached length of AWG # 20 pulse wire.

.3 Readouts shall be suitable for dual measure (Metric/Imperial) readout.

3 Execution

3.1 INSTALLATION

.1 Install to devices in accordance with the Manufacturer's instructions.

.2 Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.

.3 Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

.4 Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Provide syphon on gauges in steam systems. Extend nipples and syphons to allow clearance from insulation.

.5 Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-3/8" (60mm) for installation of thermometer sockets. Ensure sockets allow clearance from thermal insulation.

.6 Install thermometer sockets adjacent to control systems thermostat, transmitter, or sensor sockets. Where thermometers are provided on local panels, duct or pipe mounted thermometers are provided on local panels, duct or pipe mounted thermometers are not required.

.7 Coil and conceal excess capillary on remote element instruments.

.8 Provide instruments with scale ranges selected according to service with largest appropriate scale.

.9 Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45° off vertical.

.10 Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

.11 Locate test plugs adjacent thermometers and thermometer sockets.

END OF SECTION

1 General

1.1 SUMMARY

.1 Pipe and equipment hangers and supports.
.2 Equipment bases and supports.
.3 Sleeves and seals.
.4 Flashing and sealing equipment and pipe stacks.

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 Refer to the latest edition of the following:
- .1 ASME B31.1- Power Piping.
- .2 ASME B31.2 - Fuel Gas Piping.
- .3 ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
- .4 ASME B31.9 - Building Services Piping.
- .5 ASTM A 125, Standard Specification for Steel Springs, Helical, Heat-Treated.
- .6 ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .7 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- .8 ASTM A 563, Standard Specification for Carbon and Alloy Steel Nuts.
- .9 MSS SP 58, Pipe Hangers and Supports - Materials, Design and Manufacture
- .10 MSS SP 69, Pipe Hangers and Supports - Selection and Application
- .11 MSS SP 89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .12 NFPA 13 - Installation of Sprinkler Systems.
- .13 NFPA 14 - Installation of Standpipe, Private Hydrants, and Hose Systems.
- .14 UL 203 - Pipe Hanger Equipment for Fire protection Service.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 20 01 00 for the following items:
- .1 Pipe hangers and supports.
- .2 Rooftop pipe and equipment supports.

2 Products

2.1 PIPE HANGERS AND SUPPORTS

.1 Manufacturers:
- .1 Anvil
- .2 Myatt
- .3 Hunt

.2 Refrigerant Piping:
- .1 Conform to ASME B31.5.
- .2 Hangers for pipe sizes 1/2" to 1-1/2" (13 to 38mm) shall be carbon steel, adjustable swivel, with a split ring.
- .3 Hangers for pipe sizes 2" to 4" (50 to 100mm) shall be carbon steel, adjustable, clevis.
- .4 Multiple pipe or trapeze hangers for pipe sizes up to 4” (100mm) shall be steel channels with welded spacers and hanger rods.
- .5 Multiple pipe or trapeze hangers for pipe sizes 6" (150mm) and over shall be steel channels with welded spacers, hanger rods, and cast iron rollers.
- .6 Wall support for pipe sizes up to 3" (75mm) shall be cast iron hooks.
- .7 Wall support for pipe sizes 6" (150mm) and over shall be welded steel brackets and wrought steel clamps with adjustable steel yoke and cast iron roller.
- .8 Vertical supports shall be steel riser clamp.
- .9 Floor support for up to 4" (100mm) shall be cast iron adjustable pipe saddles, lock nut, nipple, floor flange, and concrete pier or steel support.
- .10 Floor support for pipe sizes 6" (150mm) and over shall be adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- .11 Copper pipe supports shall be carbon steel ring, adjustable, copper plated.

.3 Plumbing Piping
- .1 Conform to ASME B31.9.
- .2 Hangers for pipe sizes 1/2" to 1-1/2" (15 to 38mm) shall be malleable iron, adjustable swivel, split ring.
- .3 Hangers for pipe sizes 2" to 4" (50 to 100mm) shall be carbon steel, adjustable, clevis.
- .4 Hangers for pipe sizes 6" (150mm) and greater shall be adjustable steel yoke, cast iron pipe rollers, double hanger.
- .5 Multiple pipe or trapeze hangers shall be steel channels with welded supports or spacers and hanger rods.
- .6 Multiple pipe or trapeze hangers for pipe Sizes 6" (150mm) and greater shall be steel channels with welded supports or spacers and hanger rods, with a cast iron roller.
- .7 Wall support for pipe sizes up to 3" (75mm) shall be cast iron hook.
- .8 Wall support for pipe sizes 4" (100mm) and greater shall be welded steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron pipe roll.
- .9 Vertical supports shall be steel riser clamp.
- .10 Floor supports for pipes 4” (100mm) and smaller shall be cast iron adjustable pipe saddles with lock nut, nipples, floor flanges, and a concrete pier or steel support.
- .11 Floor supports for pipe sizes 6” (150mm) and larger shall be adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
- .12 Copper pipe support shall be a carbon steel ring with an adjustable and be copper plated.

2.2 ACCESSORIES

.1 Hanger rods shall be galvanized, carbon steel with continuous threads.

.2 Inserts shall be malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.3 ROOFTOP PIPE SUPPORTS

.1 Acceptable Manufacturers;
- .1 Portable Pipe Hangers, Inc.
- .2 Unistrut
- .3 Tri-Kon Systems
- .4 Roof Top Blox (pipes only)

.2 Pre-engineered pipe support system including;
- .1 Bases: Injection moulded high density polypropylene with UV inhibitors and antioxidants with a density of 55.8lbs/ft^3 (894kg/m^3).
- .2 Framing: 1-5/8" (41.3mm) strut or 1-7/8" (47.6mm) strut as required for loading, roll formed 3 sided tubular shape with perforated 9/16” (14mm) holes at 1-7/8” (48mm) centres on three sides with a t2 gauge thickness. All framing members shall be hot dipped galvanized steels as per ASTM A123 with a mill finish.
- .3 Hardware: Hot dipped galvanized steel.

.3 Pipe Supports and Hangers: Conform to MSS SP-58 and MSS SP-69, fabricated of carbon steel. Single roller supports for piping subject to expansion and contraction.

.4 Metal surfaces hot dip galvanized free of roughness, whiskers, unsightly spangles, icicles, runs, barbs, sags, droplets and other surface blemishes. Galvanizing shall conform to ASTM A123 for tubing and to ASTM A153 for hardware and accessories.

.5 Shop Drawings: Manufacturer shall provide detailed shop drawings to indicate layout and supporting capacities of system components with installation and assembly instructions for each application. Shop drawings shall bear the signature and seal of a Professional Engineer licensed in the jurisdiction of the project.

3 Execution

3.1 INSTALLATION

.1 Install hangers, supplies and attachments as required to properly support from the building structural elements and to the Manufacturer's instructions including best trade practises.

3.2 INSERTS

.1 Provide inserts for placement in concrete formwork.

.2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

.3 Provide hooked rod to concrete reinforcement section for inserts carrying pipes over 4" (100mm).

.4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

.5 Where inserts are omitted, drill through the concrete slab from below and provide through-bolts with recessed square steel plates and nuts above slab.

3.3 PIPE HANGERS AND SUPPORTS

.1 Support horizontal piping as scheduled.

.2 Install hangers to provide a minimum 1/2" (13mm) space between finished covering and adjacent work.

.3 Place hangers within 12" (300mm) of each horizontal elbow.

.4 Use hangers with 1-1/2" (38mm) minimum vertical adjustment.

.5 Support horizontal cast iron pipe adjacent to each hub, with 5’ (1.5m) maximum spacing between hangers.

.6 Support vertical piping at every other floor. Support vertical cast iron pipe at each floor at hub.

.7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

.8 Support riser piping independently of connected horizontal piping.

.9 Provide copper plated hangers and supports for copper piping.

.10 Design hangers for pipe movement without disengagement of supported pipe.

.11 Prime coat exposed steel hangers and supports. Refer to Division 09. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.4 EQUIPMENT BASES AND SUPPORTS

.1 Provide housekeeping pads of concrete, minimum 4" (100mm) thick and extending a maximum of 6" (150mm) beyond supported equipment. Refer to Division 03.

.2 Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

.3 Construct supports of steel members. Steel pipe and fittings. Brace and fasten with flanges bolted to structure.

.4 Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 ROOFTOP PIPE AND DUCT SUPPORT

.1 Coordinate installation of supports and bases with roofing work. Ensure that roofing surfaces are smooth and flat and are ready to receive work.

.2 Use care in installation of support systems not to damage roofing, flashing, equipment or related materials.

.3 Install and secure support systems in strict accordance with Manufacturer's written instruction.

.4 Consult Manufacturer of roofing system to determine if walk pads are required. Provide and fully adhere walk pads to roof system where required.

.5 Bases and support framing shall be located as indicated on shop drawings provided by support system manufacturer and as specified herein. The support of all piping shall be complete and adequate, whether or not all required devices are shown.

.6 The use of wood or wire for supporting piping will not be permitted.

.7 Deflection of pipes shall not exceed 1/240th of the span.

.8 Accurately locate and align bases. Where applicable, replace gravel around bases. Set framing posts into bases and assemble framing structure as indicated.

.9 Use galvanized fasteners for galvanized framing and use stainless steel fasteners for stainless steel framing.

3.6 FLASHING

.1 Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

.2 Seal roof, floor, shower and mop sink drains watertight to adjacent materials.

.3 Provide curbs for mechanical roof installations 14" (350mm) minimum high above finished roofing surface. Flash and counter flash with sheet metal; seal watertight. Attach counter flashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

.4 Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 SLEEVES

.1 Set sleeves in position in formwork. Provide reinforcing around sleeves.

.2 Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

.3 Extend sleeves through floors 1" (25mm) above finished floor level. Caulk sleeves.

.4 Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing insulation and caulk. airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

.5 Install chrome plated steel escutcheons at finished surfaces.

3.8 SCHEDULES

.1 For Steel or Iron Pipes

Pipe Diameter mm (ins)	Horizontal Spacing of Supports mm (ins)	Threaded Rod Diameter mm (ins)
13 (1/2)	1500 (60)	10 (3/8)
19 (3/4)	1800 (72)	10 (3/8)
25 (1)	2100 (84)	10 (3/8)
32 (1-1/4)	2400 (96)	10 (3/8)
38 (1-1/2)	2400 (96)	10 (3/8)
50 (2)	2400 (96)	10 (3/8)
65 (2-1/2)	2400 (96)	13 (1/2)
75 (3)	2400 (96)	13 (1/2)
100 (4)	2400 (96)	16 (5/8)
150 (6)	3600 (144)	19 (3/4)
200 (8)	3600 (144)	22 (7/8)

.2 For Copper Tubing, Annealed Steel Tubing or PVC Piping

Pipe Diameter mm (ins)	Horizontal Spacing of Supports mm (ins)	Threaded Rod Diameter mm (ins)
13 (1/2)	1500 (60)	10 (3/8)
19 (3/4)	1500 (60)	10 (3/8)
25 (1)	1800 (72)	10 (3/8)
32 (1-1/4)	2100 (84)	10 (3/8)
38 (1-1/2)	2400 (96)	10 (3/8)
50 (2)	2400 (96)	10 (3/8)
65 (2-1/2)	3000 (120)	13 (1/2)
75 (3)	3000 (120)	13 (1/2)
100 (4)	3000 (120)	16 (5/8)

.3 For Cast Iron (MJ) Pipes

Pipe Diameter mm (ins)	Horizontal Spacing of Supports mm (ins)	Threaded Rod Diameter mm (ins)
< 75 (3)	1000 (40)	16 (5/8)
>100 (4)	1000 (40)	19 (3/4)

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Comply with the General Requirements of Section 20 01 00 and the Common Work Elements of Section 20 05 00.

.2 Read and conform to:
- .1 The Contract CCDC 2, Stipulated Price Contract as amended in the Contract Documents;
- .2 Division 01 requirements and documents referred to therein.

1.2 CRITERIA

.1 Equipment shall be adequately isolated to maintain acceptable NC noise levels in occupied areas of the building as outlined in the following schedule. Approved, qualified personnel shall take noise measurements over complete audible frequency range in occupied zones adjacent to mechanical equipment rooms and main duct shafts and in other locations to ensure NC levels are achieved.

.2 Acceptable NC noise levels are as follows:

Classrooms	28 to 30
Office-Private	32 to 34
Open Plan	36 to 38
Conference/Boardrooms	30 to 32

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 20 01 00 for the following items:
- .1 A complete set of approved shop drawings of mechanical equipment, piping and ductwork which is to be isolated.
- .2 Include as a minimum the basic equipment layout, length and width; installed operating weights of equipment to be isolated and distribution of weight at isolation points.
- .3 Product Date
  - .1 Manufacturer's product data including details of materials, construction, dimensions of individual components, installation details and finishes.
  - .2 Schedule of vibration isolator type with location and static and dynamic load on each.
  - .3 Vibration Isolation Base Details:
    - .1 Detail fabrication, including anchorages and attachments to structure and to supported equipment.
    - .2 Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment and cantilever loads.

1.4 SUBMITTALS

.1 Submit according to Section 01 33 00.

1.5 QUALITY ASSURANCE

.1 Provide steel welding in accordance with CSA W59, by fabricators certified by the Canadian Welding Bureau to CSA W47.1.

.2 Isolation materials, flexible connectors, and seismic restraints shall be same Manufacturer. Select and certify using published or factory certified data.

.3 Vibration isolation manufacturer shall be a member of the Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Vibration and noise control equipment shall be as manufactured by:
- .1 Vibro-Acoustics Ltd.
- .2 Amber/Booth Company
- .3 Vibron Limited
- .4 Korfund Sampson Ltd.
- .5 Mason Industries

2.2 SPRINGS

.1 Springs shall be stable, colour coded and selected to operate at no greater than 2/3 solid deflection.

.2 Springs for outdoor or high humidity applications shall have two coats of neoprene.

.3 Outside spring diameter shall be a minimum of 0.8 times rated vertical operating height and the ratio of horizontal stiffness to vertical stiffness (kx/ky) shall be greater than 1.2 times ratio of static deflection to operating height.

2.3 SPRING MOUNTS

.1 Spring mounts shall be complete with levelling devices, 6mm (1/4”) thick ribbed rubber sound pad bonded to load plate. Fasteners shall be zinc chromate plated and mounts for outdoor or high humidity applications shall have two coats of neoprene.

.2 Mounts bolted to floor shall be complete with rubber isolation washers.

.3 Type I mounts shall be closed spring type mounts with top and bottom housings separated with neoprene rubber stabilizers.

.4 Type II mounts shall be open spring type mounts with extra stiff springs having a minimum kx/ky of 1.0.

.5 Type III mounts shall be controlled type mount with heavy rigid steel base frames, built-in vertical limit stops and removable spacers. Springs shall be extra stiff having a minimum kx/ky of 1.0. Clearances between metal parts shall be 6mm (¼”) minimum.

2.4 SPRING HANGERS

.1 Type SH shall be welded steel housing with one coat anti-rust paint, complete with colour coded stable spring, retaining cups and acoustic washer.

.2 Type SHR shall be as Type SH but shall have 25mm (1") elastomeric element in place of acoustic washer.

2.5 PAD TYPE ISOLATORS

.1 Type AA rubber waffle or ribbed pads shall be of high quality 30 durometer natural rubber, minimum of 13mm (½") thick and selected for a maximum loading of 350 kPa (50 psi).

.2 Type BB rubber-steel-rubber pads shall consist of two layers of Type AA pad, 13mm (½") thick, as specified above, bonded to 6mm (¼") steel plates. Holes shall be sleeved and complete with isolation washers.

.3 Type CC pads shall be kinetic neoprene jacketed pre-compressed moulded fibreglass.

.4 Type RLS mounts shall be elastomeric rubber with threaded insert and hold down bolt holes.

.5 Type R mounts shall be neoprene, 50mm (2") free height with natural frequency not to exceed 15 CPS at full load. Isolator shall be capable of sustaining a load of 110kg (220lbs.) with maximum deflection of 5mm (0.2").

2.6 BASES

.1 Type `A' integral fan and motor bases, complete with motor slide rails welded in place, shall have minimum vertical sections as follows:

Motor kW (HP)	Vertical Sect. mm (inch)
Up to 2.2 (3)	75 (3)
5.4 (7 1.2)	100 (4)
15 (20)	150 (6)
37 (50)	200 (8)
Over 37 (50)	250 (10)

.2 Submit sizes of reinforced bases having smaller vertical sections for approval.

.3 Type "B" channel slings shall be of structural members with gusset plates welded to the ends.

.4 Type "C" reinforced concrete inertia bases shall be a minimum of 1.5x the weight of the isolation equipment and shall be constructed using a full depth channel iron perimeter and reinforcing rods welded in place. The concrete shall be rated at 3,000 (20 MPa). Design shall be by the isolation suppliers.

.5 Steel bases and inertia bases shall clear sub-bases by at least 50mm (2"). Block and shim bases level, so that duct and pipe connections can be made to a rigid system at operating level before isolator adjustment.

2.7 FACTORY BUILT SILENCERS

.1 All silencers shall be completely prefabricated of non-combustible materials and shall have a minimum insertion loss and a maximum air pressure drop as shown in `Silencer Schedule'.

.2 Acoustic media shall be placed under compression and protected from air erosion by minimum 0.853mm (22 gauge) thick perforated galvanized sheet metal liner.

.3 Silencers with internal air velocities above 22.86 m/s (4,500 fpm) shall have acoustic media additionally protected from erosion by glass fibre cloth.

.4 Silencers shall have 50mm (2”) slip connections unless specified otherwise. Silencers shall be painted with anti-rust prime coat. Provide lifting lugs on silencers with cross sectional dimensions larger than 600mm (24”).

.5 Class I silencers of rectangular construction shall have an outer shell of 0.853mm (22 gauge) thick minimum sheet metal and shall be used in ductwork not in excess of 1,000 Pa (4” WG) or the design pressure of the silencer, whichever is lower.

.6 Class 2 silencers of rectangular construction shall have an outer sheet of 1.55mm (16 gauge) thick sheet metal with continuous welded seams and painted with one anti-rust prime coat. Splitter shall be reinforced with formed channels. End connections shall be steel angle flanges. They shall be used in ducts over 1,000 Pa (4” WG).

.7 Circular silencers shall be all welded construction with a minimum 1.60mm (16 gauge) sheet metal outer shell and 0.853mm (22 gauge) perforated sheet metal inner shell for diameter over 600mm (24”). For smaller sizes 1.31mm (18 gauge) and 0.701mm (24 gauge) respectively shall be acceptable.

.8 Submit certified data of pressure drop, insertion loss and generated noise of silencers. Data shall be certified by a qualified independent testing laboratory.

.9 Insertion loss shall consist of sound pressure level in the diffuse sound field of a reverberant room where a silencer is substituted for the same length of empty duct and the remainder of the system unchanged.

.10 Test method used by the independent testing laboratory certifying the silencer data shall be fully described.

.11 Certification of the pressure drop; insertion loss and generated noise data shall be based upon tests of the same silencer for all measurements.

2.8 VIBRATION ISOLATING ROOF CURBS

.1 Provide a matching vibration isolating roof curb, for each roof top A/C unit so specified. Equivalent to Mason RSC-DB.

.2 Curbs shall be selected based on Manufacturer's data provided for the actual units to be installed. Isolation shall be steel spring type, 50mm (2”) deflection, stabilized to prevent lateral movement of the roof top units in excess of 6mm (¼”).

.3 Curbs shall incorporate neoprene or other approved weatherproofing sheet to completely seal the space between the top and bottom rails.

.4 Springs shall be cadmium plated and hardware shall be cadmium plated or galvanized.

.5 The floating member of the curb shall be fitted with two layers of 15mm (½") waterproof drywall, with staggered joints. The floating member shall incorporate perimeter steel flanges and intermediate cross members across the curb to support the drywall. The drywall shall be tight to the ducts or any other penetrations. Flexible duct connections shall be installed below.

3 Execution

3.1 INSTALLATION

.1 'T' shaped concrete inertia pump bases shall be used only where shown.

.2 Equipment not specifically named in the application of isolation shall be isolated with deflection required to meet noise criteria.

.3 Isolate motor driven mechanical equipment (except propeller fans, domestic water, in-line circulators and sump and sewage pumps).

.4 Isolate equipment containing water, such as refrigeration machines and cooling towers, where draining or flooding results in unloading and loading spring forces with Type III mounts having built-in limit bolts.

.5 Mount base mounted pumps, air compressors and reciprocating refrigeration compressors on concrete inertia bases, unless specifically detailed otherwise. Mount bases on vibration isolators as described herein. Extend each inertia slab sufficiently beyond vertical pipe connections to equipment so that base elbows may be bolted and grouted to slab. Provide air compressors with braided metallic flexible pipe connectors. Give special consideration to single cylinder air compressors to ensure that unbalanced forces are suitably restrained. Include flexible pipe hose connector on rupture disc refrigerant relief vent line. Hose and its liner shall be suitable for refrigerant used. Minimum hose working pressure shall be 1,035 kPa (150 psi).

.6 Provide pipe connections of nominal size up to and including 300mm (12") diameter on isolated pumps with flanged steel spool pieces for future installation, if required, of flexible hoses.

.7 Locate spool pieces between system isolating valve and pump. Flange to flange lengths of spool pieces shall be as follows:

Pipe Size mm (inches)	Length mm (inches)
50 (2)	450 (18)
65-75 (2 1/2 and 3)	616 (24)
100-125 (4 and 5)	625 (25)
150-300 (6 to 12)	635 (25 1/2)

.8 Equip centrifugal pumps over 2.2 kW (3 hp) except basement located pumps, with box type recessed open spring mounts, located under corners and projections of inertia bases.

.9 Equip centrifugal pumps, 2.2 kW (3 hp) or less, except with basement mounted pumps with rubber-steel-rubber pads, Type "BB" or rubber-in-shear isolators, Type "RLS" located under corners and projections of inertia bases.

.10 Equip basement located pumps and equipment with rubber-steel-rubber pads, Type "RSR" located as described above.

.11 Support equipment such as fans, heating convertors, heat exchangers, packaged boilers, inter-coolers, water and steam header assemblies condensate receivers, deaerator and domestic hot water tanks, located in mechanical equipment rooms, mechanical areas and fan rooms above a basement lowest level and including any mezzanine levels, on spring vibration isolators, located as required so that piping systems and equipment connected to same shall be completely isolated from the building structure.

.12 Support the above equipment when located in mechanical equipment rooms, mechanical areas or fan rooms at a basement lowest level where floor slab is directly in contact with ground, on rubber-steel-rubber pads Type "BB". Isolate equipment, mounted in rooms or areas over excavated crawl spaces with spring vibration isolators.

.13 Locate isolation for equipment as necessary to provide a stable support under saddles, frames and projections of equipment.

.14 Resiliently support piping 63mm (2½") size and larger located within pipe shafts, duct shafts, equipment and fan rooms, and also first two hangers on such piping leaving these rooms or areas with combination spring hangers or spring mounts. This shall include piping in any cooling tower areas which are open to outside and piping in other locations where spring isolators are specifically indicated. Nearest point of support to any piece of isolated equipment shall have an operating static defection of twice equipment isolator deflection but not more than 50mm (2"). Next two supports shall have a static deflection, equal to isolator deflection but not more than 50mm (2"). Other spring hangers and spring mounts shall have a minimum static deflection of 25mm (1"). Provide spring hangers at first two support locations of all piping either side of building expansion joints.

.15 All piping from heating pumps shall be supported with minimum 25mm static deflection spring mounts or hangers as follows:

Pipes up to 100mm (4") diameter	First 3 points of support
125mm (5") to 200mm (8") diameter	First 4 points of support
250mm (10") diameter and over	First 6 points of support

.16 Transition from duct sizes indicated to silencer sizes note in Silencer Schedule.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Engineering, design and calculations for seismic restraint.
.2 Seismic restraints for equipment, piping and ductwork.
.3 Coordination with Section 20 05 29.
.4 Coordination with Section 20 05 48.

1.2 RELATED REQUIREMENTS

.1 Comply with the General Requirements of Section 20 01 00 and the Common Work Results of Section 20 05 00.

.2 Read and conform to:
  .1 The Contract CCDC 2, Stipulated Price Contract as amended in the Contract Documents;
  .2 Division 01 requirements and documents referred to therein.

1.3 REFERENCES

.1 Ontario Building Code.
.2 American National Standards Institute (ANSI).
.3 American Society of Testing and Materials (ASTM) A36/A36M Specification for Carbon Structural Steel.
.4 American Society of Testing and Materials (ASTM) E488 Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
.5 ASHRAE Standard "A Practical Guide to Seismic Restraint".
.6 Canadian Standards Association (CSA) W59 for welding.
.7 CAN/CSA-S832, Guideline for Seismic Risk Reduction of Operation and Function Components (OFCs) of Buildings.
.8 Manufacturers Standardization Society (MSS) ANSI/MSS SP-127, Bracing for Piping Systems: Seismic-Wind-Dynamic Design, Selection, and Application.
.9 NFPA 13.
.10 SMACNA “Seismic Restraint Manual: Guidelines for Mechanical Systems”.
.11 SMACNA "HVAC Duct Construction Standards".
.12 Underwriters Laboratories of Canada (ULC).
.13 Good engineering practice.

1.4 SUBMITTALS

.1 Submit according to Section 01 33 00.

.2 All vibration isolation and seismic restraint systems shall be by one Manufacturer.

.3 Submit shop drawings for all devices specified herein and as indicated on the Drawings. Submittals shall include dimensions, materials, attachment and anchorage requirements. Indicate compliance with each specification item herein.

.4 Provide calculations for selection of seismic restraints, certified by a qualified Professional Engineer licensed in the jurisdiction where the project is located.

.5 Written certification from a Professional Engineer stating that supports systems, anchorage and equipment have been designed according to requirements for a post-disaster structure at time of shop drawing submittals.

.6 Shop Drawings:

.1 Provide detailed drawings of all seismic control measures for equipment, ductwork, and piping that is to be seismically restraint.

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

.3 Indicate inertia bases and locate vibration isolators, with static and dynamic loads on each.

.4 Shop drawings shall include engineering calculations for all seismic restraints and attachment including combining shear and tensile loads. A Professional Engineer shall sign, seal and date the calculations.

.5 Product Data: details of materials, construction, dimensions of individual components, installation details, and finishes. Schedule of seismic control component type with location and static and dynamic load on each. For interlocking snubbers; include load deflection curves up to 13mm (½") deflection in x, y, and z planes.

.6 Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.

.7 Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed design requirements.

1.5 DEFINITIONS

.1 Relevant Importance Category for the Building in accordance with the Ontario Building Code:

.1 Post-disaster: buildings which are required to be operational after a disaster.

.2 SFRS: acronym for Seismic Force Resisting System.

.3 SCS: acronym for Slack Cable Restraint System.

1.6 SUMMARY

.1 This Section covers design, supply and installation of complete SFRSs for all equipment, ductwork, and piping.

.2 SFRS shall be fully integrated into and compatible with noise and vibration controls.

.3 Systems and equipment shall be required to be operational during and after a seismic event.

.4 During a seismic event, SFRS shall prevent systems and equipment from causing personal injury and from moving from normal position.

1.7 PROJECT RECORD DOCUMENTS

.1 Record actual locations of seismic restraints including attachment points.

1.8 SEISMIC ENGINEER

.1 Professional Engineer holding a Certificate of Authorization where the work is to be performed (i.e. Province of Ontario) with a minimum of 5 years' experience in seismic design, and minimum of $1 million Professional Liability Insurance including Errors and Omissions Insurance.

.2 At the completion of the project, the Seismic Engineer shall review the installations on site, and shall prepare a written report, with a letter signed, sealed and dated by the Seismic Engineer, certifying that the installations have been completed in accordance with their design and shop drawings.

1.9 SEISMIC CONTROL MEASURES

.1 A single Supplier shall provide seismic design, vibration isolation, and seismic restraint. Coordinate with Section 20 05 48.

.2 Seismic restraints are to be provided for all operational and functional components of building services in accordance with current requirements of the Ontario Building Code.

.3 Cable restraint systems, rod stiffener clamps and seismic isolator capacities shall be verified by an independent test laboratory.

.4 Connection materials shall be selected by and site specific designs to be prepared by the Seismic Engineer. The Seismic Engineer may select and specify materials and anchors to be provided by the Contractor where this is appropriate.

.5 Contractor shall ensure that the Seismic Engineers' requirements and Specification are met.

1.10 EXTRA MATERIALS

.1 Furnish extra materials described below which match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

.1 Seismic Snubber Units: Furnish replacement neoprene inserts for snubbers.

2 Products

2.1 GENERAL

.1 Resilient Isolation Washers and Bushings: One-piece, moulded neoprene, having a durometer 50, +/- 5, with a flat washer face.

.2 Seismic Snubbers: Factory fabricated using welded structural steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

.3 Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.

.4 Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to

ASTM E488. All isolation and seismic restraint products supplied by common manufacturer / supplier.

2.2 FINISHING

.1 Manufacturer's standard paint applied to factory-assembled and factory-tested equipment, before shipping.

.2 Powder coating on springs and housings.

.3 Electro-galvanize hardware.

.4 Hot-dip galvanize metal components for exterior use.

.5 Baked enamel coat metal components for interior use.

.6 Color-code or otherwise mark vibration isolation and seismic control devices to indicate capacity range.

2.3 SEISMIC FORCE RESTRAINT SYSTEM (SFRS)

.1 Provide seismic restraints for all equipment, ductwork and piping covered by Mechanical Contractor except as noted herein.

.2 Piping and ductwork crossing building expansion joints shall have provision for building motion.

.3 Provide seismic restraints for all flues with a minimum of one transverse and one lateral brace. Restraints shall be designed as per ductwork of equivalent weight.

.4 Fasteners and attachment points shall resist the same load as seismic restraints.

.5 The SFRS shall provide gentle and steady cushioning action and avoid high impact loads.

.6 Provide positive seismic and wind restraints on those systems and components required by the Ontario Building Code and the authority having jurisdiction (AHJ).

- .1 Design Spectral response acceleration for short periods, $S_a(0.2)$ shall be 0.150.
- .2 Site Classification, shall be C.
- .3 Acceleration based site coefficient; F_a shall be 1.0.
- .4 Importance Factor for Earthquake Loads, I_E shall be 1.5.
- .5 Wind reference velocity pressure, q (1/50 year) shall be 0.36 kPa.

.7 Design and installation of SFRS shall follow the guidelines listed in CAN/CSA-S832 and the SMACNA Seismic Restraint Manual (unless specifically overridden by this Section). Where contradictions occur the more stringent requirement shall be followed.

.8 Unless indicated otherwise, seismic restraints shall be capable of a minimum 2 g horizontal force in any direction.

.9 The SFRS shall restrain seismic forces in all directions.

.10 SFRS of Piping systems shall be compatible with:

- .1 Expansion, anchoring and guiding requirements.
- .2 Equipment vibration isolation and equipment SFRS.

.11 SFRS utilizing cast iron, threaded pipe, and other brittle materials shall not be permitted.

.12 Attachments to concrete structure:
- .1 Use high strength mechanical expansion anchors.
- .2 Drilled or power driven anchors shall not be permitted.

.13 Seismic control measures shall not interfere with integrity of fire stopping.

.14 The SFRSs shall be from a single Manufacturer, acceptable Manufacturers:
- .1 Kinetics Noise Control Inc.
- .2 Mason Industries Inc.
- .3 Vibro-Acoustics (Swegon Group).
- .4 Gripple Inc.

2.4 SFRS FOR STATIC EQUIPMENT AND SYSTEMS

.1 Floor-mounted equipment and systems:
- .1 Anchor equipment to equipment supports.
- .2 Anchor equipment supports to structure.
- .3 Use size of bolts scheduled in approved shop drawings.

.2 Suspended equipment and systems:
- .1 Use one or combination of following methods:
- .2 Install tight to structure.
- .3 Cross-brace in all directions.
- .4 Brace back to structure.
- .5 Slack cable restraint system.

2.5 SLACK CABLE RESTRAINT (SCS)

.1 Seismic cable sway bracing restraints shall consist of galvanized steel aircraft cable sized to resist seismic loads with a safety factor of five . Cable end connections shall use heavy brackets, thimbles, and wire rope clips or compression sleeves.

.2 The SCS shall prevent sway in the horizontal plane, “rocking” in the vertical plane, sliding and buckling in an axial direction.

.3 Hanger rods shall be braced to withstand compressive loading and buckling.

3 Execution

3.1 INSTALLATION OF SEISMIC FORCE RESTRAINT SYSTEM

.1 General:
- .1 Restraining devices must be placed on all sides of equipment.
- .2 Secure all control panels to withstand seismic loading.
- .3 Provide additional steel brackets, inserts, bolts, cable, etc. to provide seismic restraints.
- .4 For vibrating equipment:
  - .1 The installation of seismic restraints shall not compromise vibration isolation capabilities.

.2 Install vibrating equipment on seismically rated isolators whenever possible.
.3 Where seismically rated isolators cannot be used on vibrating equipment, use non-seismic isolators and provide slack cable restraints.

.5 For non-vibrating equipment, secure the equipment to the structure by:
.1 Bolting directly to the structure.
.2 Use rigid seismic restraints.
.3 Use taught cable restraints - not slack.
.4 Rigid restraints are preferable to cable restraints as cables have no compression load capabilities.

.6 Secure brackets.

.7 Inserts shall be installed in accordance with the Manufacturer's recommendations.

.8 Prior to the installation of any seismic restraints review with the Structural Consultant the methods of attachment and loads. Be particularly aware of large loads and light steel structures.

.9 Where hanger length for piping, ductwork or equipment at a seismic bracing point exceeds 50f, provide additional rod support in accordance with SMACNA or use Mason SRC clamps.

.10 11 months after substantial performance, re-torque all bolts for seismic attachment and provide certificate.

.11 Where anchor bolt diameter is smaller than bolt hole, such as for a slot hole, use Mason 0.5 fast epoxy putty to fill gaps.

.2 Ductwork:

.1 Provide traverse bracing 9m o.c. maximum. (Except rectangular ducts 1,550mm and larger in either direction may be braced at 9.8m o.c.).

.2 Provide longitudinal bracing at 18.3m o.c. maximum. Transverse bracing for one duct section may also act as longitudinal bracing for a duct section connected perpendicular to it, if the bracing is installed within 4' of the intersection of both ducts and bracing is sized for the larger duct. Duct joints shall conform to SMACNA Duct Construction Standard. All joints in duct sections shall provide a positive fastening together of the section.

.3 A group of ducts may be combined in a larger size frame using the overall dimensions with maximum weight for selection of the members from the schedule on sheet 17 of the SMACNA Guidelines.

.4 Walls (including gypsum-board non-bearing partitions) which have ducts running through them may replace a typical transverse brace. Provide solid blockings around duct penetration at stud wall construction.

.5 Install ducts and pipes not braced with 1,150mm minimum clearance to vertical ceiling hanger wires.

.6 All sheet metal for bracing to be F_y (yield strength) = 33,000 psi.

.7 Minimum sheet metal for bracing to be 16 ga.

.8 It is the responsibility of the contractor to ascertain that an appropriate size device be selected for each individual piece of equipment.

.3 Piping:

.1 Provide restraint details on piping and equipment as follows.

.2 Vertical Piping:

.1 Attachment - Secure vertical piping at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents. Stacks shall be supported at their bases and, if over 2 stores in height, at each floor by approved metal floor clamps.
.2 Screwed pipe - Screwed pipe (I.P.S.) shall be supported at not less than every other storey height.
.3 Copper tubing - Copper tubing shall be supported at each storey for piping 40mm (1½") and larger diameter, and at not more than 1.8m (6') intervals for piping 40mm (1½") and smaller in diameter.
.4 Support pipes of other materials in accordance with the capability of the pipe to resist seismic loads.

.3 Horizontal Piping:
.1 Supports - Horizontal piping shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
.2 Screwed pipe - Screwed pipe (I.P.S.) or flanged pipe shall be supported at approximately 3m (10') intervals.
.3 Copper tubing - Copper tubing shall be supported at approximately 1.8m (6') intervals for tubing 40mm (1½") and smaller in diameter and 3m (10') intervals for tubing 50mm (2") and larger id diameter.
.4 Support pipes of other materials in accordance with the capability of the pipe to resist seismic loads.

.4 Provide transverse bracings at 12.2m (40') o.c. maximum unless otherwise noted.

.5 Provide longitudinal bracings at 24.4m (80') o.c. maximum unless otherwise noted. When thermal expansion or contraction is involved, provide longitudinal bracings at anchor points. The longitudinal braces and the connections must be capable of resisting the force induced by expansion and contraction.

.6 Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed within 600mm (24") of the elbow or tee of similar size.

.7 For threaded piping the flexibility may be provided by the installation of swing joints. In welded or solder joint piping the flexibility shall be provided by expansion loops or manufactured flexible connectors. For piping with manufactured ball joints select length of piping offset using "Seismic Drift" in place of "Expansion per Joint" in the Manufacturer's selection table. Seismic Drift = 0.015' per foot of height (15mm/m of height).

.8 Do not use branch lines to brace main lines.

.9 Trapeze hangers may be used. Provide flexibility in joints where pipes pass through building seismic or expansion joints, or where rigidly supported pipes connected to equipment with vibration isolators.

.10 A rigid piping system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.

.11 Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements.

.12 At vertical pipe risers, wherever possible, support the weight of the riser at a point of points above the centre of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2m (30') o.c.

.13 Cast iron pipe of all types, glass pipe and any other pipe joined with a shield and clamp assembly where the top of the pipe is 30mm (12") or more from supporting structure shall be braced on each side of a change in direction of 90° or more. Riser joints shall be braced or stabilized between floors.

.14 For gas piping, the bracing details, schedules and notes may be used except that transverse bracing shall be at 6.1m (20') o.c. maximum and longitudinal bracing at 12.2m (40') o.c. maximum. NPS 1 in., 1¼", 1½" and 2" (25, 32, 40 & 50mm) diameter pipes shall be braced the same as NPS 2½" (65mm) diameter pipe in the schedule. (No bracing is required for pipes NPS ¾" (20mm) diameter and smaller.)

.15 The seismic bracing and support of fire sprinkler piping is not part of this Specification.

.16 It is the responsibility of the Contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings.

.4 Attachment point and fasteners:

.1 Shall withstand the same maximum load that the seismic restraint is to resist and in all directions.

.2 Pipe installation shall comply with the most stringent requirement of MSS SP-127 or as indicated below.

.3 Install SFRS at least 25mm (1") from all other equipment, systems, and/or services.

.4 Where specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

.5 Co-ordinate connections with all disciplines.

.6 Vertical tanks:

.1 Anchor through housekeeping pad to structure.

.2 Provide steel bands above center of gravity.

.7 Horizontal tanks:

.1 Provide at least two straps with anchor bolts fastened to structure.

3.2 INSTALLATION OF SLACK CABLE RESTRAINT SYSTEMS

.1 Connect to suspended equipment so that axial projection of wire passes through center of gravity of equipment.

.2 Arrange bushing assemblies for anchor bolts for floor mounted equipment with resilient media between the anchor bolt and mounting hole in concrete base.

.3 Arrange bushing assemblies for anchor bolts for wall mounted equipment with resilient media where equipment or equipment mounting channels are attached to the wall.

.4 Alignment of restraints shall be installed to avoid bending of cables at connection points or across edges of adjacent equipment or building structure.

.5 Piping systems shall provide for transverse SCS at 12.2m (40') spacing maximum, longitudinal SCS at 24.4m (80') maximum or as limited by anchor/slack cable performance.

.6 Ducted systems shall provide for transverse SCS at 9.1m (30') spacing maximum, longitudinal SCS at 18.3m (60') maximum or as limited by anchor/slack cable performance.

.7 Brace a change in direction longer than 3.7m (12')

.8 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not the reverse arrangement.

.9 Orient restraint wires on ceiling hung equipment at approximately 90° to each other (in plan), tie back to structure at maximum of 45° to structure.

.10 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.

.11 Tighten cable to reduce slack to 38mm (1½") under thumb pressure. Cable shall not support weight during normal operation.

3.3 EXEMPTIONS

.1 Exemptions to SFRS shall be in accordance with the SMACNA Seismic Restraint Manual, and the Ontario Building Code:

- .1 Rectangular ducts less than 0.56m^2. (6ft^2) in cross-sectional area.
- .2 Round ducts less than 700mm in diameter.
- .3 Gas, fuel and steam piping less than 25mm inside diameter.
- .4 Piping in boiler and mechanical rooms less than 32mm (1¼") in diameter.
- .5 All other piping less than 65mm (2½") in diameter.
- .6 Equipment rigidly attached to piping or ductwork less than 34kg (75lbs.) in weight.
- .7 Equipment independently hung or flex connected less than 9kg (20lbs.) in weight.
- .8 Wall mounted equipment less than 9kg (20lbs.) in weight.
- .9 Base mounted equipment with no overturning moment, containing no hazardous material, less than 181kg (400lbs.) in weight, and is mounted on a stand less than 1200mm (4') in height.
- .10 All piping suspended by individual hangers 300mm (12") or less as measured from the top of the pipe to the bottom of the support where the hanger is attached. However, if the 300mm (12") limit is exceeded by any hanger in the run, seismic bracing shall be provided for the entire run.
- .11 The 300mm (12") exemption applies for trapeze supported systems if the distance as measured from the point of attachment to the trapeze to the point of attachment to the structure is less than 300mm (12"). Structural connections shall be a non-friction connection (no "C" clamps).

3.4 MANUFACTURER'S FIELD SERVICES

.1 Examine systems to Section 20 01 00.

.2 Inspect isolated equipment after installation and submit report. Include static deflections.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.2 REFERENCE STANDARDS

.1 ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

.1 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.

.2 Submit valve chart and schedule, including valve tag number, location, function, and valve Manufacturer's name and model number.

.3 Product Data: Provide Manufacturers catalogue literature for each product required.

.4 Manufacturer's Installation Instructions: Indicate special procedures, and installation.

2 Products

2.1 NAMEPLATES

.1 Provide laminated plastic plates with black face and white text with a minimum size of 3-1/2” x 1-1/2” x 3/32” (90mm x 40mm x 2mm), engraved with ¼” (6mm) high lettering. Use 1” (25mm) lettering for major pieces of equipment.

.2 Fasten nameplates securely in a conspicuous place. Where nameplates cannot be mounted on cool surface, provide standoffs.

.3 Identify equipment type, designation and service of areas or zone of building served.

.4 For each item of equipment which may be started automatically or remotely, add a red lamacoid plate, 2-1/2" x 9" (60mm x 230mm), reading:
"WARNING. THIS EQUIPMENT IS AUTOMATICALLY CONTROLLED AND MAY START AT ANY TIME."

2.2 TAGS

.1 Tags: Laminated three-layer plastic with engraved black letters on light contrasting background colour. Tag size minimum 1-1/2" (40mm) diameter.

.2 Chart: Typewritten letter size list in anodized aluminum frame.

2.3 STENCILS

.1 Stencils: With clean cut symbols and letters of following size:
  .1 3/4"-1-1/4" (20-30mm) Outside Diameter of Insulation or Pipe: 8" (200mm) long colour field, 1/2" (15mm) high letters.

.2 1-1/2"-2" (40-50mm) Outside Diameter of Insulation or Pipe: 8" (200mm) long colour field, 3/4" (20mm) high letters.
.3 2-1/2"-6" (65-150mm) Outside Diameter of Insulation or Pipe: 12" (300mm) long colour field, 1-1/4" (30mm) high letters.
.4 8" - 10" (200-250mm) Outside Diameter of Insulation or Pipe: 24" (600mm) long colour field, 2-1/2" (65mm) high letters.
.5 Over 10" (250mm) Outside Diameter of Insulation or Pipe: 32" (800mm) long colour field, 3-1/2" (90mm) high letters.
.6 Ductwork and Equipment: 2-1/2" (65mm) high letters.

2.4 SELF ADHESIVE PIPE AND DUCT MARKERS

.1 Vinyl: Factory fabricated vinyl, 0.13mm (5 mil) thick, preformed to fit around pipe or pipe covering.

.2 Polyester: Factory fabricated polyester, 0.05mm (2 mil) thick, coated with acrylic adhesive.

.3 Plastic: Factory fabricated plastic film, roll formed, clear laminated to protect lettering.

3 Execution

3.1 PREPARATION

.1 Degrease and clean surfaces to receive adhesive for identification materials.

.2 Prepare surfaces for stencil painting.

3.2 INSTALLATION

.1 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer (VOC content not to exceed 680 g/L).

.2 Install tags with corrosion resistant chain.

.3 Comply with standard detail on drawings, "Detail of Piping Identification".

.4 Apply stencil markings on all covered piping.

.5 Install plastic tape pipe markers completely around pipe to the Manufacturer's instructions.

.6 Identify natural gas piping in accordance with CAN1-B149.1, latest edition.

.7 Clearly identify abandoned services left in place as “ABANDONED”.

.8 Install underground plastic pipe markers 6"-8" (150-200mm) below finished grade, directly above buried pipe.

.9 Identify air handling units, fans, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

.10 Identify control panels and major control components outside panels with plastic nameplates.

.11 Identify thermostats relating to terminal boxes or valves with nameplates.

.12 Identify valves in main and branch piping with tags. Consecutively number valves in each system.

.13 Identify air terminal units and radiator valves with numbered tags.

.14 Tag automatic controls, instruments, and relays. Key to control schematic.

.15 Identify piping, concealed or exposed, with stencilled painting and plastic tape pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20'-0" (6.0m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

.16 Identify covered ductwork with stencilled painting and bare ductwork with plastic tape duct markers. Identify ductwork with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

.17 Provide colour coded self-adhesive dots to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.3 SCHEDULES

.1 Consult the Owner and identify piping, ductwork and equipment as directed;
.1 Conforming to the Owner's existing identification practices, or
.2 Conforming to the following Pipe and Valve Identification Table:

Pipe Marker Legend	Valve Tag Legend	Background Colour	Text Colour
Domestic Cold Water	DCWS	Green	White
Dom. Hot Water Supply	DHWS	Green	White
Dom. Hot Water Recirc.	DHWR	Green	White
Fire Protection Water	FPW	Red	White
Natural Gas	GAS	Yellow	Black
Refrigerant Liquid	REFL	Yellow	Black
Refrigerant Suction	REFS	Yellow	Black
Sanitary Sewer	SAN	Green	White
Sprinkler Water	SPR	Red	White
Storm Sewer	STM	Green	None
Vent		Green	White

.2 The above list is to be used as a guideline for colour coding only, and is not intended to supersede lists of other authorities or agencies. (i.e. Ministry of Environment; Ministry of Government Services, Canadian Government Standards Board).

3.4 MANUFACTURER'S NAMEPLATE

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

.2 Include registration plates, Underwriters' Laboratories and CSA approval, as required by respective agency and as specified. Indicate size, equipment model,

Manufacturer's name, serial number, voltage, cycle, phase and power of motors, all factory supplied.

.3 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

3.5 FLOW DIAGRAMS AND DIRECTORIES

.1 Provide Consultant with one electronic copy in PDF format of flow diagram of approved size for each system. Include tag schedule, designating number, service, function, and location of each tagged item and normal operating position of valves.

.2 Install where agreed with the Owner one copy of each flow diagram and valve schedule mounted in glazed frame. Provide one copy of each in the Operation and Maintenance Manual.

END OF SECTION

ACCESS DOORS

1 General

1.1 SUMMARY

.1 Access doors.

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 SUBMITTALS

.1 Product Data: Manufacturers catalogue brochure identifying product features.

.2 Shop drawings indicating materials, finishes, dimensions and methods of attachment.

2 Products

2.1 MANUFACTURES

.1 Manufacturer: Acudor.

.2 Other acceptable Manufacturers offering equivalent products, subject to shop drawing review.
.1 Cendrex
.2 Bilco

2.2 ACCESS DOORS

.1 Standard
.1 Model no. UF-5500; 12”x12” (300mm x 300mm) and smaller shall be constructed of 20 gauge galvanized steel door and frame; over 15”x15” (375mm x 375mm) shall be 18 gauge. The door shall include rounded corners and be flush with the one piece frame with a white powder coat finish. The assembly shall include concealed hinges and a standard slot screwdriver operated cam lock. Door sizes shall be as required to suit the field requirements but shall not be less than 8” x 8” (200mm x 200mm).

.2 Concealed/Recessed
.1 Model no. DW-5015; constructed of 22 gauge galvanized steel door and frame with a drywall taping bead on all sides and concealed hinge. The door shall be recessed 5/8” (16mm). The assembly shall include concealed hinges and a standard slot screwdriver operated cam lock. Door sizes shall be as required to suit the field requirements but shall not be less than 12” x 12” (300mm x 300mm).

.3 Fire Rated
.1 Model no. FB-5060; constructed of 16 gauge galvanized steel door and frame with a prime coat of white alkyd baked on enamel. The assembly shall include concealed hinges and a standard self-latching bolt operated

by a knurled knob. Door sizes shall be as required to suit the field requirements but shall not be less than 12” x 12” (300mm x 300mm).

.2 Refer to the architectural Drawings for fire resistance ratings.

3 Execution

3.1 INSTALLATION

.1 Supply access doors for access to equipment requiring service, lubrication or adjustment and all concealed valves, cleanouts, trap primers, control and volume dampers, and other such equipment.

.2 Turn over access doors to the appropriate general trade for installation under other Sections.

END OF SECTION

1 General

1.1 SUMMARY

.1 Testing, adjustment, and balancing of air systems.
.2 Sound measurement of equipment operating conditions.
.3 Vibration measurement of equipment operating conditions.

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 SEQUENCING

.1 Convene a minimum of 1 week prior to commencing the scope of work of this Section.

.2 Sequence work to commence after completion of the systems. Schedule completion of work before Substantial Completion of Project.

1.4 SCHEDULING

.1 Schedule and provide assistance in final adjustment and test of life safety system with Fire Authority.

1.5 COORDINATION

.1 Cooperate with the installing Contractor(s) in advising them of specific scheduling requirements for systems verification.

.2 Provide advice to the installing Contractor(s) regarding the location and installation of devices required to permit system balancing and measurements, prior to start of the installation work.

.3 Coordinate verification of smoke control and automatic sprinkler systems with verification of fire alarm system.

1.6 SUBMITTALS

.1 Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.

.2 Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

.3 Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.

.4 Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Consultant and for inclusion in operating and maintenance manuals.

.5 Provide reports in electronic PDF format.

.6 Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.

.7 Test Reports: Indicate data on AABC National Standards for Total System Balance forms. Submit data in Imperial and S.I. Metric units.

.8 All reports shall be prepared in electronic format using MS Word software and all tabulations shall be prepared in electronic format using MS Excel spreadsheet software. Submittals shall include an electronic copy in PDF format.

1.7 QUALITY ASSURANCE

.1 Perform total system balance to AABC National Standards for Field Measurement and Instrumentation, Total System Balance.

.2 Maintain one copy of each document on-site.

1.8 REFERENCES

.1 Ontario Building Code.
.2 Ontario Fire Code.
.3 AABC - National Standards for Total System Balance.
.4 ACG - AABC Commissioning Guideline.
.5 ADC - Test Code for Grilles, Registers, and Diffusers.
.6 ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
.7 ASHRAE Guideline 0 The Commissioning Process.
.8 ASHRAE Guideline 1 The HVAC Commissioning Process.
.9 ASHRAE Guideline 1.1 HVAC&R Technical Requirements for the Commissioning Process.
.10 ASHRAE Guideline 5 Commissioning Smoke Management Systems.
.11 ASTM E779 Determining Air Leakage Rate by Fan Pressurization.
.12 NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
.13 SMACNA - HVAC Systems Testing, Adjusting, and Balancing.
.14 SMACNA HVAC Systems Commissioning Manual.

1.9 QUALIFICATIONS

.1 Agency: Company specializing in the testing, adjusting, and balancing of systems under this Section with minimum 5 years documented experience certified by AABC.

.2 Work shall be performed under the supervision of an AABC certified Test and Balance Engineer, an NEBB Certified Testing, Adjusting and Balancing Supervisor or a registered Professional Engineer experienced in the performance of this work and licensed at the place where the Project is located.

2 Products

2.1 REFERENCE STANDARDS

.1 All equipment required for the verification of equipment and systems shall be furnished by the agency employed to conduct the Mechanical Systems Verification.

.2 Testing and measuring equipment used in the verification of the mechanical systems shall be calibrated to give true readings within the accuracy Specifications of the equipment used. A certificate of calibration from an independent testing laboratory may be required by the Consultant if there is any reason to suspect that the equipment used is giving erroneous readings. In such an event the verification agency shall re-conduct its verifications.

.3 All equipment used by the agency in its verification of mechanical systems remains the property/responsibility of the agency and is not included in the supply to the project.

3 Execution

3.1 EXAMINATION

.1 Verify that systems are complete and operable before commencing work. Ensure the following conditions:
- .1 Systems are started and operating in a safe and normal condition.
- .2 Temperature control systems are installed complete and operable.
- .3 Proper thermal overload protection is in place for electrical equipment.
- .4 Final filters are clean and in place. If required, install temporary media in addition to final filters.
- .5 Duct systems are clean of debris.
- .6 Fans are rotating correctly.
- .7 Fire and volume dampers are in place and open.
- .8 Air coil fins are cleaned and combed.
- .9 Access doors are closed, and duct end caps are in place.
- .10 Air outlets are installed and connected.
- .11 Duct system leakage is minimized.
- .12 Hydronic systems are flushed, filled, and vented.
- .13 Pumps are rotating correctly.
- .14 Proper strainer baskets are clean and in place.
- .15 Service and balance valves are open.

.2 Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

.3 Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

.1 Prepare a TAB Plan that includes strategies and step by step procedures.

.2 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Consultant to facilitate spot checks during testing.

.3 Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES

.1 Prepare test reports for pumps, fans, inlets and outlets and as required to complete the work.

.2 Air Handling Systems: Adjust to within +/- 5% of design for supply systems and +/- 10% of design for return and exhaust systems.

.3 Air Outlets and Inlets: Adjust total to within +10% and -5% of design to space. Adjust outlets and inlets in space to within +/- 10% of design.

.4 Hydronic Systems: Adjust to within +/- 10% of design.

3.4 ADJUSTING

.1 Ensure recorded data represents actual measured or observed conditions.

.2 Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

.3 After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

.4 Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

.5 At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Consultant.

.6 Check and adjust systems approximately 6 months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

.1 Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

.2 Make air quantity measurements in ducts by pitot tube traverse of entire cross-sectional area of duct.

.3 Measure air quantities at air inlets and outlets.

.4 Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

.5 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

.6 Vary total system air quantities by adjustment of fan speeds. Provide drive changes as required, including variable frequency drives, pulleys, sheaves and belts. Vary branch air quantities by damper regulation.

.7 Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

.8 Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan.

.9 Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

.10 Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

.11 Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating and ventilation.

.12 Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 in.wg. (12.5 Pa) positive static pressure near the building entries.

.13 For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections are properly made and confirm proper operation for automatic variable air volume temperature control.

3.6 WATER SYSTEM PROCEDURE

.1 Adjust water systems at all points 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 flows 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 variable frequency drives, balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

.6 Where available pump capacity 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.

3.7 SCHEDULES

.1 Equipment requiring testing, adjusting and balancing:
- .1 Plumbing Pumps
- .2 Terminal Heat Transfer Unit
- .3 Fans
- .4 Air Terminal Units
- .5 Air Inlets and Outlets

.2 Report Forms
- .1 Title Page:

.1 Name of Testing, Adjusting, and Balancing Agency
.2 Address of Testing, Adjusting, and Balancing Agency
.3 Telephone number of Testing, Adjusting, and Balancing Agency
.4 Project name
.5 Project location
.6 Project Architect
.7 Project Engineer
.8 Project Contractor
.9 Project altitude
.10 Report date

.2 Summary Comments:
.1 Design versus final performance
.2 Notable characteristics of system
.3 Description of systems operation sequence
.4 Summary of outdoor and exhaust flows to indicate amount of building pressurization
.5 Nomenclature used throughout report
.6 Test conditions

.3 Instrument List:
.1 Instrument
.2 Manufacturer
.3 Model number
.4 Serial number
.5 Range
.6 Calibration date

.4 Pump Data:
.1 Identification/number
.2 Manufacturer
.3 Size/model
.4 Impeller
.5 Service
.6 Design flow rate, pressure drop, BHP
.7 Actual flow rate, pressure drop, BHP
.8 Discharge pressure
.9 Suction pressure
.10 Total operating head pressure
.11 Shut off, discharge and suction pressures
.12 Shut off, total head pressure

.5 Air Cooled Condenser:
.1 Identification/number
.2 Location
.3 Manufacturer
.4 Model number
.5 Serial number
.6 Entering DB air temperature, design and actual
.7 Leaving DB air temperature, design and actual
.8 Number of compressors

.6 Air Moving Equipment
.1 Location
.2 Manufacturer

.3 Model number
.4 Serial number
.5 Arrangement/Class/Discharge
.6 Air flow, specified and actual
.7 Return air flow, specified and actual
.8 Outside air flow, specified and actual
.9 Total static pressure (total external), specified and actual
.10 Inlet pressure
.11 Discharge pressure
.12 Sheave Make/Size/Bore
.13 Number of Belts/Make/Size
.14 Fan RPM

.7 Return Air/Outside Air Data:
.1 Identification/location
.2 Design air flow
.3 Actual air flow
.4 Design return air flow
.5 Actual return air flow
.6 Design outside air flow
.7 Actual outside air flow
.8 Return air temperature
.9 Outside air temperature
.10 Required mixed air temperature
.11 Actual mixed air temperature
.12 Design outside/return air ratio
.13 Actual outside/return air ratio

.8 Exhaust Fan Data:
.1 Location
.2 Manufacturer
.3 Model number
.4 Serial number
.5 Air flow, specified and actual
.6 Total static pressure (total external), specified and actual
.7 Inlet pressure
.8 Discharge pressure
.9 Sheave Make/Size/Bore
.10 Number of Belts/Make/Size
.11 Fan RPM

.9 Duct Traverse:
.1 System zone/branch
.2 Duct size
.3 Area
.4 Design velocity
.5 Design air flow
.6 Test velocity
.7 Test air flow
.8 Duct static pressure
.9 Air temperature
.10 Air correction factor

.10 Duct Leak Test:
- .1 Description of ductwork under test
- .2 Duct design operating pressure
- .3 Duct design test static pressure
- .4 Duct capacity, air flow
- .5 Maximum allowable leakage duct capacity times leak factor
- .6 Test apparatus
  - .1 Blower
  - .2 Orifice, tube size
  - .3 Orifice size
  - .4 Calibrated
- .7 Test static pressure
- .8 Test orifice differential pressure
- .9 Leakage

.11 Terminal Unit Data:
- .1 Manufacturer
- .2 Type, constant, variable, single, dual duct
- .3 Identification/number
- .4 Location
- .5 Model number
- .6 Size
- .7 Minimum static pressure
- .8 Minimum design air flow
- .9 Maximum design air flow
- .10 Maximum actual air flow
- .11 Inlet static pressure

.12 Air Distribution Test Sheet:
- .1 Air terminal number
- .2 Room number/location
- .3 Terminal type
- .4 Terminal size
- .5 Area factor
- .6 Design velocity
- .7 Design air flow
- .8 Test (final) velocity
- .9 Test (final) air flow
- .10 Percent of design air flow

3.8 VERIFICATION CHECKLIST

.1 Prepare a series of checklists to record the verification of each item of equipment and each system. Submit a draft of each checklist to the Consultant for review and approval. Discuss comments offered by the Consultant and include improvements as directed.

.2 Checklists shall include the following as a minimum;
- .1 A record of the nameplate data for each equipment item and each associated motor,
- .2 A list of observations appropriate to the equipment item or system with space adjacent to indicate whether the item was satisfactory or unsatisfactory,

.3 A list of observations appropriate to the equipment item or system with space adjacent to indicate whether the item was satisfactory or unsatisfactory,

.4 Appropriate space for recording comments and/or instructions given during observations.

3.9 EQUIPMENT VERIFICATION

.1 Test the operation of all equipment installed under Division 21, 22, and 23 according to instructions in appropriate articles of this Division. Advise installing Contractor of any required adjustments or replacements to ensure that equipment is operating as intended. Retest equipment after adjustment or replacement.

.2 Ensure that the Contractor has given proper advance notification to all persons required to be present as tests are conducted. Refer to Section 20 01 00 and Section 20 05 00.

.3 Instrumentation: Verify installation of air filter gauges, pumps, thermometers, thermometer wells, pitot traverse stations, and flow-measuring devices ensuring that:

.1 Location of points for readings is appropriate to measure what it is intended to measure;

.2 The scale range is appropriate to place the normal reading near mid-range of the scale;

.3 Proper positioning of instrumentation to allow reading from a convenient location, and for easy access.

.4 Filters Inspection: Visually inspect each filter installation. Verify adjustment of latching devices, installation of end spacers in filter boxes, and proper latching and sealing of access doors. Verify the installation of new (clean) filter media after Contractor's start-up procedures.

.5 Pre-start-up Inspection:

.1 Verify proper equipment mounting and setting.

.2 Verify that control, interlock, and power wiring are complete.

.3 Verify proper alignment of motors and drives.

.4 Verify proper piping connections and accessories.

.5 Verify that lubrication is complete.

.6 First Run Observation:

.1 Verify direction of rotation.

.2 Verify setting of safety controls.

.3 Monitor heat build-up in bearings.

.4 Check motor loads against nameplate ratings.

.7 Equipment Checkout:

.1 Verify the proper overload heater sizes.

.2 Verify function of safety and operating controls.

.3 Verify proper operation of equipment.

.4 Report on inspection, observation, and checkout procedures.

.8 Stuffing Boxes and Packing Glands: Verify adjustment of boxes on pump shafts and packing glands on valve stems.

.9 Motor Rotation: Visually inspect and verify the direction of motor rotation. It is possible for motor rotation to have been checked by the electrician when power connections were made on temporary electric power, then when final connections were made to the permanent transformer bank, crossed phasing may reverse the rotation of all three-phase motors on the system.

.10 Overload Heaters: Verify supply voltage to each equipment. If the applied voltage is different from the motor nameplate, determine whether the applied voltage is within the range allowed under the motor guarantee. If not, take the necessary action to have the Contractor change the motor or the applied voltage. When the voltage is off the nameplate value, but within the allowable range, compute the equivalent amperage at nameplate voltage and compare to the overload heater amperage rating range. Then, consider whether the ambient temperature of the starter is above, below, or the same as the ambient temperature are not the same. Advise the Contractor to use overload heaters of higher range for "hot area" starters or ones of lower range for "cold area" starters to compensate the heater trip point for heat gains or losses with the environment.

.11 Alignment of Drives: Verify the alignment of drives, belt and direct coupled, and the adjustment of belt tensioners.

.12 Control Diagrams and Sequences: Provide for coordination with work under the automatic control systems to have the control diagrams and sequences of operation corrected to "as installed", reflecting changes brought about in response to Contract modifications and to the more pragmatic changes in diagrams and sequences to make the installed system control the building systems as intended by the Designer.

.13 Safety and Operating Control Setpoints: Systematically verify the safety and operating controls of equipment, including an operational check of associated control sequences.

.14 Fin Straightening: Inspect finned surface heat transfer coils for damaged fins and advise Contractor of repairs required.

.15 Verify that Manufacturer's start-up procedures have been performed and that equipment is installed in accordance with the Manufacturer's written installation recommendations.

.16 Where work is noted to be done in stages a complete air balance and verification report will be required at the end of each stage.

3.10 PIPING SYSTEMS CERTIFICATION

.1 Review the Drawings, Specifications, and installed work to ensure that systems may be properly balanced in accordance with Drawings. Advise the installing Contractor of any additional requirements for effective balancing.

.2 Verify that all strainers are clean.

.3 Examine water in system to determine if it has been treated and is clean.

.4 Check pump rotation.

.5 Check diaphragm expansion tanks to ensure that fill pressure is adequate (re. static head of systems plus 5 psig or 12 psig minimum (35 kPa or 83 kPa minimum).

.6 Check open expansion tanks to make sure they are not air bound and that the system is full of water.

.7 Witness all piping tests.

3.11 AIR SYSTEM VERIFICATION

.1 Review Drawings, Specifications and installed work to ensure that systems may be properly balanced in accordance with Drawings. Advise installing Contractor of any additional requirements for effective balancing.

.2 In air handling systems which include supply fans with variable frequency drives, airflows shall be verified to design with all filters clean and with all filters loaded to filter Manufacturer's recommended final (change-out) resistance. Motor and drive capacity to accommodate full range of filter loadings shall be verified.

.3 In air handling systems which include supply fans without variable frequency drives, air filters shall be verified to design airflows with air filters loaded so that the air pressure drop through each filter is equal to the average of the Manufacturers listed initial resistance and recommended final resistance.

.4 Test and record blower rpm for each fan and air handling unit.

.5 Test and record motor full load amperes.

.6 Make Pitot tube traverse of main supply and obtain operating air quantities at fans.

.7 Test and record system static pressures, suction and discharge.

.8 Test and record system operating re-circulated air quantities.

.9 Test and record system operating outside air quantities.

.10 Test and record entering dry bulb air temperatures (heating and cooling coils).

.11 Test and record entering wet bulb air temperatures (heating and cooling coils).

.12 Test and record leaving dry bulb air temperatures (heating and cooling coils).

.13 Test and record leaving wet bulb air temperatures (cooling coils only).

.14 Measure airflow in all main and zone branch supply and return air ducts.

.15 Test and record airflow at each diffuser, grille, and register.

.16 Witness and verify results of duct leakage tests conducted under Section 23 31 00.

.17 Tabulate and certify test results on suitable forms and submit Consultant for approval and record. Identity each diffuser, grille, and register as to location and area. Identify and list size, type, and Manufacturer of diffusers, grilles, registers, and all testing equipment. Use Manufacturer's rating on all equipment to make required calculations.

END OF SECTION

1 General

1.1 SUMMARY

.1 Ductwork insulation
.2 Duct liners
.3 Insulation jackets

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 Refer to the latest edition of the following:
- .1 ASTM A167 – Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- .2 ASTM A240 - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels for General Applications.
- .3 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .4 ASTM C195 - Mineral Fiber Thermal Insulating Cement.
- .5 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
- .6 ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- .7 ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .8 ASTM C552 - Cellular Glass Thermal Insulation.
- .9 ASTM C553 - Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .10 ASTM C592 - Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
- .11 ASTM C612 - Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
- .12 ASTM C916 - Adhesives for Duct Thermal Insulation.
- .13 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- .14 ASTM C1071 - Fibrous Glass Duct Lining Insulation (Thermal Sound Absorbing Material).
- .15 ASTM C1126 - Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
- .16 ASTM C1136 - Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- .17 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .18 ASTM E96 - Water Vapour Transmission of Materials.
- .19 ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
- .20 ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .21 NAIMA National Insulation Standards.

.22 NFPA 96 – Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
.23 NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
.24 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
.25 UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.
.26 CGSB-Canadian General Standards Board.
.27 CAN/CGSB-51.9 Mineral Fibre Thermal Insulation for Piping and Round Ducting.
.28 CAN/CGSB-51.10 Mineral Fibre Board Thermal Insulation
.29 CAN/CGSB-51.11 Mineral Fibre Thermal Insulation Blanket.
.30 CAN/CGSB-5140 Mineral Insulation, Flexible, Elastomeric, Unicellular, Sheet & Pipe Cover-up.
.31 CAN/CGSB-51-GP-52 Ma Vapour Barrier, Jacket and Facing Material for Pipe, Duct & Equipment Thermal Insulation.

1.4 QUALITY ASSURANCE

.1 Materials: Flame spread/smoke developed rating of 25/50 or less to ULC S102 and ASTM E84.

1.5 QUALIFICATIONS

.1 Applicator: Company specializing in performing the work of this Section with minimum 3 years experience.

1.6 DELIVERY, STORAGE AND HANDLING

.1 All material shall be transported, shipped, stored, handled and installed in such a manner as not to degrade the quality, serviceability, or appearance. Material warranties shall not be voided by actions of the Contractor.

.2 Deliver materials to site in original factory packaging, labelled with Manufacturer's identification, including product density and thickness.

.3 Store insulation in original wrapping and protect from weather and construction traffic.

.4 Protect insulation against dirt, water, chemical, and mechanical damage.

1.7 SUBMITTALS

.1 Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

.2 Manufacturer's Instructions: Indicate installation procedures which ensure acceptable workmanship and installation standards will be achieved.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Maintain ambient temperatures and conditions required by Manufacturers of adhesives, mastics, and insulation cements.

.2 Maintain temperature during and after installation for minimum period of 24 hours.

2 Products

2.1 GENERAL

.1 Packaging and labelling: Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to project site shall have the Manufacturer's stamp or label attached giving the name of the Manufacturer, brand and description of material. Insulation materials shall be asbestos-free.

.2 Surface burning characteristics: Materials shall have a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50, when tested in accordance with NFPA 255, ASTM E84 or UL 723. Insulation materials located exterior to the building perimeter are not required to be fire-rated.

2.2 GLASS FIBRE, FLEXIBLE

.1 Resin bonded fibrous glass blanket with a damage-resistant, flame retardant, reinforced aluminum foil facing. Owens Corning SOFTR Duct Wrap insulation. Duct Wrap Insulation: ASTM C1290, Type III, to a maximum service temperature of 250°F (121°C), and ASTM C1136, Type II, facing material. Provide the following:
- .1 Type 75: 0.75lb./ft^3 (12kg/m^3) density: 1-1/2", 2", 2.2" or 3" (38mm, 51mm, 56mm or 76mm) thickness.
- .2 Type 100: 1.0lb./ft^3 (16kg/m^3) density: 1-1/2" or 2" (38mm or 51mm) thick, or
- .3 Type 150: 1.5lb./ft^3 (24kg/m^3) density: 1-1/2" or 2" (38mm or 51mm) thick.

.2 The duct wrap insulation shall consist of a blanket of glass fibers factory-laminated to a foil reinforced kraft (FRK) vapor retarder facing with a 2" (50mm) (min.) stapling and taping flange on one edge.

.3 Other acceptable Manufacturers offering equivalent products:
- .1 Manson Insulation
- .2 Knauf Insulation Inc.
- .3 Johns Manville

.4 Insulation: ASTM C553; flexible, non-combustible blanket.
- .1 'k' value: ASTM C518,0.27, 0.25 and 0.23 at 75°F (24°C).
- .2 Maximum moisture absorption: 0.20% by volume.

.5 Vapour Barrier Jacket:
- .1 Kraft paper with glass fibre yarn and bonded to aluminized film.
- .2 Moisture vapour transmission: ASTM E96; 0.02 perm.
- .3 Secure with pressure sensitive tape.

.6 Vapour Barrier Tape: Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

.7 Outdoor Vapour Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black colour.

.8 Tie Wire: Annealed steel, 1/16" (1.5mm).

2.3 GLASS FIBRE, RIGID

.1 Rigid resin bonded fibrous glass board with a damage-resistant, flame retardant, reinforced aluminum foil facing. Owens Corning Type 705 insulation. Service temperature range 0°F (-18°C) to 450°F (232°C).

.2 Other acceptable Manufacturers offering equivalent products:
- .1 Manson Insulation
- .2 Knauf Insulation Inc.
- .3 Johns Manville

.3 Insulation: ASTM C612; rigid, non-combustible blanket.
- .1 'k' value: ASTM C518,0.23 at 75°F (24°C).
- .2 Maximum moisture absorption: 0.20% by volume.
- .3 Density: 3.0lbs/ft^3 (48kg/m^3).

.4 Vapour Barrier Jacket:
- .1 Kraft paper with glass fibre yarn and bonded to aluminized film.
- .2 Moisture vapour transmission: ASTM E96; 0.04 perm.
- .3 Secure with pressure sensitive tape.

2.4 MINERAL WOOL, FLEXIBLE

.1 Blanket mineral fibre type roll form insulation, 1.5lbs/ft^3 (24.0kg/m^3) density, 38mm (1-1/2") thick, with a factory applied vapour barrier facing. Johns Manville Duct Wrap Type 150 "Microlite".

.2 Other acceptable Manufacturers offering equivalent products:
- .1 Knauf Insulation Inc.
- .2 Manson Insulation Products Ltd

2.5 MINERAL WOOL, RIGID

.1 Preformed rigid mineral fibre board type insulation, 3.0lb./ft^3 (48.1kg/m^3) density, with a "k" factor of 0.23 at 75°F (24°C), with a factory applied reinforced aluminum foil and kraft paper facing. Johns Manville Type 814 "Spin-Glas".

.2 Other acceptable Manufacturers offering equivalent products:
- .1 Knauf Insulation Inc.
- .2 Manson Insulation Products Ltd.

2.6 ELASTOMERIC INSULATION

.1 Acceptable Manufacturers:
- .1 Armacell AP Armaflex,
- .2 APArmaflex SA,
- .3 ArmaTuff laminated Sheets and Rolls.

.2 Insulation material shall be a flexible, closed-cell elastomeric insulation in tubular or sheet form to ASTM C 534, "Specification for preformed elastomeric cellular thermal insulation in sheet and tubular form."

.3 Insulation materials shall have a closed-cell structure to prevent moisture from wicking.

.4 Insulation material shall be manufactured without the use of CFC's, HFC's or HCFC's formaldehyde free, low VOC's, fibre free, dust free and shall resist mould and mildew.

.5 Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ULC S102, ASTM E 84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive, and all materials shall pass simulated end-use fire tests.

.6 Materials shall have a maximum thermal conductivity of 0.27Btu-in./h-ft²- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.

.7 Materials shall have a maximum water vapour transmission of 0.08perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision.

.8 The material shall be manufactured under an independent third party supervision testing program covering the properties of fire performance, thermal conductivity and water vapour transmission.

2.7 JACKETS

.1 Canvas Jacket: UL listed.
- .1 Fabric: ASTM C921, 220g/m², plain weave cotton treated with dilute fire retardant lagging adhesive.
- .2 Lagging Adhesive: Compatible with insulation.

.2 Mineral Fibre Jacket: Asphalt impregnated and coated sheet, 2.45kg/m².

.3 PVC Plastic
- .1 Jacket: ASTM C921, One piece moulded type fitting covers and sheet material.
  - .1 Minimum Service Temperature: -31°F (-35°C).
  - .2 Maximum Service Temperature: 151°F (66°C).
  - .3 Moisture Vapour Transmission: ASTM E96; 0.03perm inches.
  - .4 Maximum Flame Spread: ASTM E84; 25 or less.
  - .5 Maximum Smoke Developed: ASTM E84; 50 or less.
  - .6 Thickness: 20mil (0.5mm) minimum.
- .2 Colour: standard off-white.
- .3 Covering Adhesive Mastic: Compatible with insulation, maximum VOC content of 50 g/L.
- .4 Manufacturer:
  - .1 Johns Manville Ceel-Co 300 series
  - .2 Speedline Smoke Safe
  - .3 Proto Corp.

.4 Weatherproof Jacketing: White, zero permeability, all weather, multi-layered laminate coated with an aggressive cold weather acrylic adhesive, superior resistance to weathering, mold, UV and extreme environmental conditions. Provide at all exterior insulated duct work:
- .1 Product: VentureClad “1577CW-WM” by 3M or approved equivalent.

2.8 ACCESSORIES

.1 Adhesives and finishes shall be as recommended by the insulation Manufacturer and shall comply with Section 20 05 00. Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings specified.

.2 Vapour retarder lap adhesive shall be water based, and fire retardant.

.3 Tapes shall be of cloth reinforced aluminum, soft adhesive with minimum 2" (50mm) width.

.4 Tie wire shall be of 1/16" (1.5mm) ø stainless steel.

.5 Fasteners shall be of 1/8" (4mm) diameter pins, with 1-1/2” (38mm) square clips. Clip pin length to suit insulation thickness.

.6 Bands shall be 1/2" (13mm) wide 1/4" (6mm) thick galvanized steel.

.7 Facing shall be of 1" (25mm) galvanized steel hexagonal wire mesh attached on both faces of insulation.

3 Execution

3.1 GENERAL

.1 Do not insulate:
- .1 Pre-insulated flexible and rigid ductwork.
- .2 Flexible connections. and
- .3 Fire dampers

3.2 EXAMINATION

.1 Verify that ductwork has been tested before applying insulation materials.

.2 Apply insulation after the required tests have been completed and approved by the Consultant.

.3 Verify that surfaces are clean, foreign material removed, and dry.

3.3 INSTALLATION

.1 Install insulation to TIAC National Installation Standards.

.2 Apply insulation materials, accessories, jackets and finishes in accordance with Manufacturer's written instructions and as specified.

.3 Ductwork that includes internal acoustical linings shall be thermally insulated on the duct exterior as specified in this Section.

.4 Insulated ductwork conveying air below ambient temperature:
- .1 Provide insulation with vapour barrier jackets.
- .2 Finish with tape and vapour barrier jacket.
- .3 Continue insulation through walls, sleeves, hangers, and other duct penetrations.
- .4 Insulate entire system including fittings, joints, flanges, and expansion joints.

.5 Insulated ductwork conveying air above ambient temperature:
- .1 Provide with or without standard vapour barrier jacket.
- .2 Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- .3 Continue insulation through walls, sleeves, hangers, and other duct penetrations.
- .4 Insulate entire system including fittings, joints, flanges, and expansion joints.

.6 Ductwork exposed in mechanical equipment rooms and finished spaces below shall be finished with canvas jacket sized for finish painting.

.7 External Duct Insulation Application:
- .1 Secure rigid insulation with adhesive tape or wires.
- .2 Install insulation without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
- .3 Seal penetrations by mechanical fasteners with adhesive tape.
- .4 Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- .5 Weatherproof Jacketing:
  - .1 Install weatherproof jacketing in accordance with Manufacturer's written recommendations.
  - .2 Ensure continuous air / vapour barrier on all rooftop ductwork.

.8 Duct and Plenum Liner Application:
- .1 Adhere insulation with adhesive for 90% coverage.
- .2 Secure insulation with mechanical liner fasteners. Refer to SMACNA Standards for spacing.
- .3 Seal and smooth joints. Seal and coat transverse joints.
- .4 Seal liner surface penetrations with adhesive.
- .5 Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.4 TOLERANCE

.1 Substituted insulation materials: Thermal resistance within 10% at normal conditions, as materials indicated.

3.5 DUCT INSULATION

.1 Insulate new and/or altered ductwork and re-insulate existing ductwork where insulation has been removed or damaged as follows:

Service	Type	Insulation Thickness ins. (mm)
Air supply rectangular	Rigid	1 (25)
Air supply round	Flexible	1 (25)
Exhaust 72" (1.8m) from outside rectangular	Rigid	3 (75)
Exhaust 72" (1.8m) from outside round	Flexible	3 (75)

Rectangular air supply run outs to terminal units < 120” (3.0m)	Rigid	1 (25)
Round air supply run outs to terminal units < 120” (3.0m)	Flexible	1 (25)
Exposed ductwork in warehouse or garage areas	Not required	Not required
Ductwork exterior of building envelope	Rigid	2 layers of 2 (50)

.2 In-line supply duct silencers shall be insulated to match the supply duct insulation.

END OF SECTION

1 General

1.1 SUMMARY

.1 Equipment insulation
.2 Covering

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 Refer to the latest edition of the following:
- .1 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .2 ASTM A167 - Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet and Strip.
- .3 ASTM A240 - Chromium and Chromium Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels for General Applications.
- .4 ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- .5 ASTM C195 - Mineral Fibre Thermal Insulating Cement.
- .6 ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
- .7 ASTM C449/C449M - Mineral Fibre Hydraulic-setting Thermal Insulating and Finishing Cement.
- .8 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
- .9 ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- .10 ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .11 ASTM C547 - Mineral Fibre Pipe Insulation.
- .12 ASTM C552 - Cellular Glass Thermal Insulation.
- .13 ASTM C553 - Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .14 ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.
- .15 ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- .16 ASTM C591 - Unfaced Preformed Cellular Polyisocyanurate Thermal Insulation.
- .17 ASTM C592 - Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
- .18 ASTM C610 - Moulded Expanded Perlite Block and Pipe Thermal Insulation.
- .19 ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- .20 ASTM C916 - Adhesives for Duct Thermal Insulation.
- .21 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- .22 ASTM C1126 - Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.

.23 ASTM C1136 - Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
.24 ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
.25 ASTM D1667 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).
.26 ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
.27 ASTM E84 - Surface Burning Characteristics of Building Materials.
.28 ASTM E96 - Water Vapour Transmission of Materials.
.29 NFPA 255 - Surface Burning Characteristics of Building Materials.
.30 UL 723 - Surface Burning Characteristics of Building Materials.
.31 NAIMA National Insulation Standards.
.32 CAN/CG5B-51.11 Mineral Fibre Thermal Insulation Blanket.
.33 CAN/CG5B-51-GP-52 Ma Vapour Barrier, Jacket & Facing Material For Pipe Duct & Equipment Thermal Insulation.
.34 CAN/CG5B-51-GP-53 M Jacketing, Polyvinyl Chloride Sheet for Insulating Pipes, Vessels of Round Ducts.

1.4 QUALITY ASSURANCE

.1 Materials: Flame spread/smoke developed rating of 25/50 or less to ULC S102 and ASTM E84.

1.5 QUALIFICATIONS

.1 Applicator: Company specializing in performing the work of this Section with minimum 3 years experience.

1.6 DELIVERY, STORAGE AND HANDLING

.1 All material shall be transported, shipped, stored, handled and installed in such a manner as not to degrade the quality, serviceability, or appearance. Material warranties shall not be voided by actions of the Contractor.

.2 Deliver materials to site in original factory packaging, labelled with Manufacturer's identification, including product density and thickness.

.3 Store insulation in original wrapping and protect from weather and construction traffic.

.4 Protect insulation against dirt, water, chemical, and mechanical damage.

1.7 SHOP DRAWINGS

.1 Product Data: Provide product description, list of materials and thickness for each service, and locations.

.2 Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Maintain ambient temperatures and conditions required by Manufacturers of adhesives, mastics, and insulation cements.

.2 Maintain temperature during and after installation for minimum period of 24 hours.

2 Products

2.1 GENERAL

.1 Packaging and labelling: Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to project site shall have the Manufacturer's stamp or label attached giving the name of the Manufacturer, brand and description of material. Insulation materials shall be asbestos-free.

.2 Surface burning characteristics: Materials shall have a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50, when tested in accordance with NFPA 255, ASTM E84 or UL 723. Insulation materials located exterior to the building perimeter are not required to be fire-rated.

2.2 GLASS FIBRE, FLEXIBLE

.1 Resin bonded fibrous glass blanket with a damage-resistant, flame retardant, reinforced aluminum foil facing. Owens Corning SOFTR Duct Wrap insulation. Duct Wrap Insulation: ASTM C1290, Type III, to a maximum service temperature of 250°F (121°C), and ASTM C1136, Type II, facing material. Provide the following:
- .1 Type 75: 0.75lb/ft^3 (12kg/m^3) density: 1-1/2", 2", 2.2" or 3" (38mm, 51mm, 56mm or 76mm) thickness.
- .2 Type 100: 1.0lb/ft^3 (16kg/m^3) density: 1-1/2" or 2" (38mm or 51mm) thick, or
- .3 Type 150: 1.5lb/ft^3 (24kg/m^3) density: 1-1/2" or 2" (38mm or 51mm) thick.

.2 The duct wrap insulation shall consist of a blanket of glass fibers factory-laminated to a foil reinforced kraft (FRK) vapor retarder facing with a 2" (50mm) (min.) stapling and taping flange on one edge.

.3 Other acceptable Manufacturers offering equivalent products:
- .1 Manson Insulation
- .2 Knauf Insulation Inc.
- .3 Johns Manville

.4 Insulation: ASTM C553; flexible, non-combustible blanket.
- .1 'k' value : ASTM C518,0.27, 0.25 and 0.23 at 75°F (24°C).
- .2 Maximum moisture absorption: 0.20% by volume.

.5 Vapour Barrier Jacket:
- .1 Kraft paper with glass fibre yarn and bonded to aluminized film.
- .2 Moisture vapour transmission: ASTM E96; 0.02 perm.
- .3 Secure with pressure sensitive tape.

.6 Vapour Barrier Tape: Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

.7 Outdoor Vapour Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black colour.

.8 Tie Wire: Annealed steel, 1/16" (1.5mm).

2.3 GLASS FIBRE, RIGID

.1 Rigid resin bonded fibrous glass board with a damage-resistant, flame retardant, reinforced aluminum foil facing. Owens Corning Type 705 insulation. Service temperature range 0°F (-18°C) to 450°F (232°C).

.2 Other acceptable Manufacturers offering equivalent products:
- .1 Manson Insulation
- .2 Knauf Insulation Inc.
- .3 Johns Manville

.3 Insulation: ASTM C612; rigid, non-combustible blanket.
- .1 'k' value : ASTM C518,0.23 at 75°F (24°C).
- .2 Maximum moisture absorption: 0.20% by volume.
- .3 Density: 3.0lbs/ft^3 (48kg/m^3).

.4 Vapour Barrier Jacket:
- .1 Kraft paper with glass fibre yarn and bonded to aluminized film.
- .2 Moisture vapour transmission: ASTM E96; 0.04 perm.

.5 Secure with pressure sensitive tape.

2.4 MINERAL WOOL, FLEXIBLE

.1 Blanket mineral fibre type roll form insulation, 1.5lbs/ft^3 (24.0kg/m^3) density, 38mm (1-1/2") thick, with a factory applied vapour barrier facing. Johns Manville Duct Wrap Type 150 "Microlite".

.2 Other acceptable Manufacturers offering equivalent products:
- .1 Knauf Insulation Inc.
- .2 Manson Insulation Products Ltd.

2.5 MINERAL WOOL, RIGID

.1 Preformed rigid mineral fibre board type insulation, 3.0lb/ft^3 (48.1kg/m^3) density, with a "k" factor of 0.23 at 75°F (24°C), with a factory applied reinforced aluminum foil and kraft paper facing. Johns Manville Type 814 "Spin-Glas".

.2 Other acceptable Manufacturers offering equivalent products:
- .1 Knauf Insulation Inc.
- .2 Manson Insulation Products Ltd.

2.6 ELASTOMERIC INSULATION

.1 Acceptable Manufacturers:
- .1 Armacell AP Armaflex,
- .2 APArmaflex SA,
- .3 ArmaTuff laminated Sheets and Rolls.

.2 Insulation material shall be a flexible, closed-cell elastomeric insulation in tubular or sheet form to ASTM C 534, "Specification for preformed elastomeric cellular thermal insulation in sheet and tubular form."

.3 Insulation materials shall have a closed-cell structure to prevent moisture from wicking.

.4 Insulation material shall be manufactured without the use of CFC's, HFC's or HCFC's formaldehyde free, low VOC's, fibre free, dust free and shall resist mould and mildew.

.5 Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ULC S102, ASTM E 84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive, and all materials shall pass simulated end-use fire tests.

.6 Materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft²- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.

.7 Materials shall have a maximum water vapour transmission of 0.08perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision.

.8 The material shall be manufactured under an independent third party supervision testing program covering the properties of fire performance, thermal conductivity and water vapour transmission.

2.7 JACKETS

.1 Canvas Jacket: UL listed.
- .1 Fabric: ASTM C921, 220g/m², plain weave cotton treated with dilute fire retardant lagging adhesive.
- .2 Lagging Adhesive: Compatible with insulation.

.2 Mineral Fibre (Outdoor) Jacket: Asphalt impregnated and coated sheet, 2.45kg/m².

.3 PVC Plastic
- .1 Jacket: ASTM C921, One piece moulded type fitting covers and sheet material.
- .2 Minimum Service Temperature: -31°F (-35°C).
- .3 Maximum Service Temperature: 151°F (66°C).
- .4 Moisture Vapour Transmission: ASTM E96; 0.03perm inches.
- .5 Maximum Flame Spread: ASTM E84; 25 or less.
- .6 Maximum Smoke Developed: ASTM E84; 50 or less.
- .7 Thickness: 20mil (0.5mm) minimum.
- .8 Colour: standard off-white.
- .9 Covering Adhesive Mastic: Compatible with insulation, maximum VOC content of 50 g/L.
- .10 Manufacturer;
- .11 Johns Manville Ceel-Co 300 series
- .12 Speedline Smoke Safe
- .13 Proto Corp.

2.8 ACCESSORIES

.1 Adhesives and finishes shall be as recommended by the insulation Manufacturer and shall comply with Section 20 05 00. Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings specified.

.2 Vapour retarder lap adhesive shall be water based, and fire retardant.

.3 Tapes shall be of cloth reinforced aluminum, soft adhesive with minimum 2" (50mm) width.

.4 Tie wire shall be of 1/16" (1.5mm) ø stainless steel.

.5 Fasteners shall be of 1/8" (4mm) diameter pins, with 1-1/2" (38mm) square clips. Clip pin length to suit insulation thickness.

.6 Bands shall be 1/2" (13mm) wide 1/4" (6mm) thick galvanized steel.

.7 Facing shall be of 1" (25mm) galvanized steel hexagonal wire mesh attached on both faces of insulation.

3 Execution

3.1 GENERAL

.1 Do not insulate:
- .1 Factory pre-insulated equipment,
- .2 Access plates,
- .3 ASME stamps, and
- .4 Manufacturer's nameplates.

3.2 EXAMINATION

.1 Verify that components to be insulated are complete and tested before applying insulation materials.

.2 Apply insulation after the required tests have been completed and approved by the Consultant.

.3 Verify that surfaces are clean, foreign material removed, and dry.

3.3 INSTALLATION

.1 Install insulations to TIAC National Installation Standards.

.2 Apply insulation materials, accessories, jackets and finishes in accordance with Manufacturer's written instructions and as specified.

.3 On exposed equipment to be thermally insulated cover seams in least visible locations.

.4 Apply insulation close to equipment by grooving, scoring, and bevelling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

.5 Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapour barrier cement.

.6 Insulated equipment containing fluids below ambient temperature, insulate entire system.

.7 Fibre glass insulated equipment containing fluids below ambient temperature: Provide vapour barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapour barrier adhesive.

.8 For hot equipment containing fluids 140°F (60°C) or less, do not insulate flanges and unions, but bevel and seal ends of insulation.

.9 For hot equipment containing fluids over 140°F (60°C), insulate flanges and unions with removable sections and jackets.

.10 Fibre glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapour barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

.11 Inserts and Shields:

.1 Application: Equipment 1-1/2" (38mm) diameter or larger.

.2 Shields: Galvanized steel between hangers and inserts.

.3 Insert location: Between support shield and equipment and under the finish jacket.

.4 Insert configuration: Minimum 6" (150mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.

.5 Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

.12 Finish insulation at supports, protrusions, and interruptions.

.13 Equipment in mechanical equipment rooms or finished spaces shall be finished with PVC jacket.

.14 Cover glass fibre insulation with metal mesh and finish with heavy coat of insulating cement.

.15 Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

.16 Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.4 TOLERANCE

.1 Substituted insulation materials: Thermal resistance within 10% at normal conditions, as materials indicated.

3.5 EQUIPMENT INSULATION

.1 Insulate new or altered equipment and re-insulate existing equipment where insulation has been removed or damaged as follows:

Mineral Fibre – Hot Surfaces 20°C to 400°C	**Thickness ins (mm)**
Expansion tanks, air separators	2 (50)
Any other equipment operating at a high temperature	2 (50)
Flexible Elastomeric Unicellular Sheet – Cold Surfaces	**Thickness ins (mm)**
Roof drain sumps	1-1/2 (38)
Water meters	1-1/2 (38)
Water closet carriers	1-1/2 (38)
Strainer heads in cold piping	2 (50)
Any other equipment operating at low temperature	1-1/2 (38)

END OF SECTION

1 General

1.1 SUMMARY

.1 Piping insulation
.2 Jackets
.3 Accessories

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 Refer to the latest edition of the following:
- .1 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .2 ASTM A167 – Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet and Strip.
- .3 ASTM A240 – Chromium and Chromium Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels for General Applications.
- .4 ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- .5 ASTM C195 - Mineral Fibre Thermal Insulating Cement.
- .6 ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
- .7 ASTM C449/C449M - Mineral Fibre Hydraulic-setting Thermal Insulating and Finishing Cement.
- .8 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
- .9 ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- .10 ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .11 ASTM C547 - Mineral Fibre Pipe Insulation.
- .12 ASTM C552 - Cellular Glass Thermal Insulation.
- .13 ASTM C553 – Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .14 ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.
- .15 ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- .16 ASTM C591 - Unfaced Preformed Cellular Polyisocyanurate Thermal Insulation.
- .17 ASTM C592: Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
- .18 ASTM C610 - Moulded Expanded Perlite Block and Pipe Thermal Insulation.
- .19 ASTM C612: Mineral Fiber Block and Board Thermal Insulation.
- .20 ASTM C916: Adhesives for Duct Thermal Insulation.
- .21 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- .22 ASTM C1126: Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.

.23 ASTM C1136: Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
.24 ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
.25 ASTM D1667 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).
.26 ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
.27 ASTM E84 - Surface Burning Characteristics of Building Materials.
.28 ASTM E96 - Water Vapour Transmission of Materials.
.29 NFPA 255 - Surface Burning Characteristics of Building Materials.
.30 UL 723 - Surface Burning Characteristics of Building Materials.

1.4 QUALITY ASSURANCE

.1 Materials: Flame spread/smoke developed rating of 25/50 or less to ULC S102 and ASTM E84.

1.5 QUALIFICATIONS

.1 Applicator: Company specializing in performing the work of this Section with minimum 3 years experience.

1.6 DELIVERY, STORAGE AND HANDLING

.1 All material shall be transported, shipped, stored, handled and installed in such a manner as not to degrade the quality, serviceability, or appearance. Material warranties shall not be voided by actions of the Contractor.

.2 Deliver materials to site in original factory packaging, labelled with Manufacturer's identification, including product density and thickness.

.3 Store insulation in original wrapping and protect from weather and construction traffic.

.4 Protect insulation against dirt, water, chemical, and mechanical damage.

1.7 SUBMITTALS

.1 Product Data: Provide product description, list of materials and thickness for each service, and locations.

.2 Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Maintain ambient temperatures and conditions required by Manufacturers of adhesives, mastics, and insulation cements.

.2 Maintain temperature during and after installation for minimum period of 24 hours.

2 Products

2.1 GENERAL

.1 Packaging and labelling: Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to project site shall have the Manufacturer's stamp or label attached giving the name of the Manufacturer, brand and description of material. Insulation materials shall be asbestos-free.

.2 Surface burning characteristics: Materials shall have a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50, when tested in accordance with NFPA 255, ASTM E84 or UL 723. Insulation materials located exterior to the building perimeter are not required to be fire-rated.

2.2 GLASS FIBRE

.1 Molded Fibrous Glass Pipe Insulation: Comply with ASTM C547, Type I, Grade A; and Type IV, Grade B; and ASTM C585, for sizes required and of a type suitable for installation on piping systems as required:
- .1 For indoor systems operating at temperatures from 0°F (-18°C) to +850°F (454°C), no heat-up schedule required: Owens Corning SSL II with ASJ Max FIBERGLAS Pipe Insulation.
- .2 For systems operating at temperatures +850°F (232°C) to 1000°F (535°C), heat-up schedule required: Owens Corning SSL II with ASJ Max FIBERGLAS Pipe Insulation.

.2 Other acceptable Manufacturers offering equivalent products:
- .1 Manson Insulation
- .2 Knauf Insulation Inc.
- .3 Johns Manville

.3 Insulation: ASTM C547; rigid moulded, non-combustible.
- .1 'k' value: ASTM C335, 0.26 at 75°F (24°C).
- .2 Operating Temperature Range: 0°F (-17°C) to 1,000°F (537°C).
- .3 Jacket temperature Range: -20°F (-29°C) to 150°F (66°C).
- .4 Maximum Moisture Absorption: <5% by weight.

.4 Vapour Barrier Jacket
- .1 ASTM C921, White kraft paper reinforced with glass fibre yarn and bonded to aluminized film.
- .2 Moisture Vapour Transmission: ASTM E96; 0.01perm.
- .3 Secure with self-sealing longitudinal laps and butt strips.
- .4 Secure with outward clinch expanding staples and vapour barrier mastic.

.5 Tie Wire: 1.3mm stainless steel with twisted ends on maximum 12" (300mm) centres. .5 Vapour Barrier Lap Adhesive: Compatible with insulation.

.6 Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool, VOC content not to exceed 80g/L.

.7 Fibrous Glass Fabric
- .1 Cloth: Untreated; 9oz/yd² (305g/m²) weight.
- .2 Blanket: 1.0lb/ft^3 (16kg/m^3) density.

.8 Indoor Vapour Barrier Finish: Vinyl emulsion type acrylic, compatible with insulation, white colour, VOC content not to exceed 250 g/L.

.9 Outdoor Vapour Barrier Mastic: Vinyl emulsion type acrylic, compatible with insulation, white colour.

.10 Insulating Cement: ASTM C449, VOC content not to exceed 80 g/L.

2.3 ELASTOMERIC INSULATION

.1 Acceptable Manufacturers:
- .1 AP ArmaFlex White LapSeal
- .2 AP ArmaFlex Black LapSeal
- .3 AP ArmaFlex Tubes

.2 Insulation material shall be a flexible, closed-cell elastomeric insulation in tubular form to ASTM C534, "Specification for preformed elastomeric cellular thermal insulation in sheet and tubular form."

.3 Insulation materials shall have a closed-cell structure to prevent moisture from wicking.

.4 Insulation material shall be manufactured without the use of CFC's, HFC's or HCFC's formaldehyde free, low VOC's, fibre free, dust free and shall resist mould and mildew.

.5 Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ULC S102, ASTM E 84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive, and all materials shall pass simulated end-use fire tests.

.6 Materials shall have a maximum thermal conductivity of 0.27Btu-in./h-ft²- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.

.7 Materials shall have a maximum water vapour transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision.

.8 The material shall be manufactured under an independent third party supervision testing program covering the properties of fire performance, thermal conductivity and water vapour transmission.

.9 Adhesives and finishes shall be as recommended by the insulation Manufacturer and shall comply with Section 20 05 00. Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings specified.

2.4 JACKETS

.1 Canvas Jacket: UL listed.
- .1 Fabric: ASTM C921, 220 g/sq m, plain weave cotton treated with dilute fire retardant lagging adhesive.
- .2 Lagging Adhesive: Compatible with insulation.

.2 PVC Plastic

.1 Jacket: ASTM C921, One piece moulded type fitting covers and sheet material.
  .1 Minimum Service Temperature: -31°F (-35°C).
  .2 Maximum Service Temperature: 151°F (66°C).
  .3 Moisture Vapour Transmission: ASTM E96; 0.03perm inches.
  .4 Maximum Flame Spread: ASTM E84; 25 or less.
  .5 Maximum Smoke Developed: ASTM E84; 50 or less.
  .6 Thickness: 20mil (0.5mm) minimum.
.2 Colour: standard off-white.
.3 Covering Adhesive Mastic: Compatible with insulation, maximum VOC content of 50 g/L.
.4 Manufacturer;
  .1 Johns Manville Ceel-Co 300 series
  .2 Speedline Smoke Safe
  .3 Proto Corp.

2.5 ACCESSORIES

.1 Adhesives and finishes shall be as recommended by the insulation Manufacturer and shall comply with Section 20 05 00. Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings specified.

.2 Vapour retarder lap adhesive shall be water based, fire retardant.

.3 Tapes shall be of cloth reinforced aluminum, soft adhesive with minimum 2" (50mm) width.

.4 Tie wire shall be of 1/16" (1.5mm) ø stainless steel.

.5 Fasteners shall be of 1/8" (4mm) Ø pins, with 35 mm square clips. Clip length to suit insulation thickness.

.6 Bands shall be 1/2" (12mm) wide 1/4" (6 mm) thick galvanized steel.

.7 Facing shall be of 1" (25mm) galvanized steel hexagonal wire mesh attached on both faces of insulation.

2.6 LAVATORY KITS

.1 Flexible seamless moulded closed cell PVC resin, formulated with anti-microbial additive to limit the growth of fungi and bacteria to protect against heat and contusions.
  .1 McGuire PROWRAP to suit each application.
    .1 Acceptable alternates: IPS Corp., Truebro LavGuard, TCI Skal-Gard and Johns Manville Zeston Snap-Trap.

3 Execution

3.1 GENERAL

.1 Do not insulate the following:
  .1 Unions,
  .2 Cleanouts and hand holes,

.3 Chrome plated pipe work, and
.4 Flexible connections.

3.2 EXAMINATION

.1 Verify that piping has been tested before applying insulation materials.

.2 Apply insulation after the required tests have been completed and approved by the Consultant.

.3 Verify that surfaces are clean, foreign material removed, and dry.

3.3 INSTALLATION

.1 Install piping insulations to TIAC National Installation Standards.

.2 Apply insulation materials, accessories, jackets and finishes in accordance with Manufacturer's written instructions and as specified.

.3 On exposed piping, locate insulation and cover seams in least visible locations.

.4 Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
- .1 Provide vapour barrier jackets, factory applied, or field applied.
- .2 Insulate fittings, joints, and valves with moulded insulation of like material and thickness as adjacent pipe.
- .3 Finish with glass cloth and vapour barrier adhesive.
- .4 PVC fitting covers shall be used.
- .5 Insulation shall be continuous through walls, sleeves, pipe hangers, and other pipe penetrations.
- .6 Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

.5 For insulated pipes conveying fluids above ambient temperature:
- .1 Provide standard jackets, with or without vapour barrier, factory applied, or field applied.
- .2 Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
- .3 Finish with glass cloth and adhesive.
- .4 PVC fitting covers shall be used.
- .5 For hot piping conveying fluids 140°F (60°C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- .6 For hot piping conveying fluids over 140°F (60°C), insulate flanges and unions at equipment.

.6 Inserts and Shields:
- .1 Application: Piping 1-1/2" (38mm) diameter or larger.
- .2 Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
- .3 Insert Location: Between support shield and piping and under the finish jacket.
- .4 Insert Configuration: Minimum 6" (150mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
- .5 Insert Material: hydrous calcium silicate insulation.

.7 Finish insulation at supports, protrusions, and interruptions.

.8 For pipe exposed in finished spaces, finish with canvas jacket sized for finish painting. Piping exposed in mechanical rooms, finish with PVC jacket.

.9 For exterior applications, provide vapour barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapour barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. All seams shall be sealed weathertight.

3.4 TOLERANCE

.1 Substituted insulation materials: Thermal resistance within 10% at normal conditions, as materials indicated.

3.5 PIPE INSULATION

.1 Insulate new and/or altered piping and re-insulate existing piping where insulation has been removed or damaged as follows:

Service	Operating Temperature Range °F (°C)	Pipe Diameter in. (mm)	Insulation Thickness in. (mm)
All piping outside of building or in unheated spaces	0 to 850 (-18 to 454)	All sizes	2 (50)
Condensate (cold)	0 to 850 (-18 to 454)	All sizes	1 (25)
Potable Cold Water	0 to 850 (-18 to 454)	All sizes	1 (25)
Potable Hot Water and Recirculation	>105 (41)	Up to and including 1.5 (38)	1 (25)
		2 (50) and above	1-1/2 (38)
Sanitary Drainage (horizontal only)	40 to 55 (4 to 13)	All sizes	1 (25)
Storm Drainage (horizontal only)	40 to 55 (4 to 13)	All sizes	1 (25)

.2 Insulate fittings and flanges and pipe connections with insulated fitting covers.

.3 Wrap butt joints with a 4" (100mm) strip of fire resistant vapour barrier jacket cemented with lagging adhesive.

.4 Where the pipe hanger is around the insulation, provide an insulation protection shield within the pipe saddle. Coordinate with installation of hangers.

.5 Insulate all fittings, flanges and valves on pipes to provide equivalent insulation to that of adjoining pipe.

.6 Continue insulation through sleeves including specified finish.

.7 Cut back covering on strainers and finish off to expose removable head insulation.

.8 Cover expansion joints first with 24 gauge (0.7mm) galvanized metal sleeve and then insulate to provide equivalent thickness to that on adjoining pipe.

.9 Protect insulation with protection saddles where insulated pipe is supported by rollers.

.10 Insulate pipe hangers supporting piping carrying water at 70°F (21°C) or less to prevent condensation. Extend insulating material along hanger rod to height 4 times thickness of insulation. Seal insulation with vapour proof sealant.

.11 Extend pipe insulation and covering through walls, floors, ceilings, and concrete beams, unless indicated otherwise on Drawings. Protect exposed insulation extending through floors with 4" (100mm) wide strip of 18 gauge (1.3mm) galvanized iron.

.12 Pack annular space between pipe sleeves and piping or pipe covering with glass fibre insulation or rock-wool insulation. In fire rated assemblies use Dow Silicon RTV or other ULC listed materials. Seal exposed insulation with mastic.

.13 Recover exposed surfaces of insulated piping installed in exposed areas, mechanical rooms, and equipment rooms with PVC jacketing and PVC fitting covers installed in accordance with Manufacturer's instructions.

.14 Insulate and cover exposed surfaces of waste connections, traps, hot and cold supply risers and valves at each lavatory and sink designated for "barrier free" use with PVC insulated fitting covers specifically designed for this application. Vinyl material is not to exceed flame spread rating of 150, and if intended to be used in high buildings, its smoke developed classification does not exceed 300.

.15 Provide aluminum metal jacketing on all exposed thermally insulated piping located outdoors and as indicated on the Drawings.

.16 Insulate sprinkler and standpipe main take-off from domestic water to a point approximately 6' (1800mm) after electrically supervised valve or as indicated on the Drawings.

3.6 REFRIGERANT PIPE INSULATION

.1 Insulate all refrigerant suction and hot gas piping and fittings with flexible foamed plastic pipe insulation. Insulation shall fit pipe. Thickness shall be as follows: 1/2" (13mm) thick for pipe 1" (25mm) and smaller; 3/4" (19mm) thick for pipe 1-1/4" (32mm) to 2" (50mm); 1" (25mm) thick for pipes 2-1/2" (65mm) and larger.

.2 Slip insulation on to tubing before tubing sections and fittings are assembled. Keep slitting of insulation to a minimum. Seal all joints in the insulation with Armaflex 520 BLV. Insulate flexible pipe connectors.

.3 On insulation exposed outside the building, place "slit" joint seams on bottom of pipe and provide two coats of grey Armaflex finish. Extend insulation through pipe support clamps. Provide a 6" (150mm) long, 20 gauge (1.1mm) galvanized steel sleeve around pipe insulation at each support.

END OF SECTION

1 General

1.1 MECHANICAL ELECTRICAL SCHEDULE

.1 The following Mechanical Electrical Schedule is provided to assist the Contractor in co-ordinating the efforts of the sub-trades. The assignment of work among Sub-Contractors is the Contractor's responsibility and the Contractor is free to amend the schedule as they deem necessary.

.2 The Mechanical Electrical Schedule also describes work that is required and may or may not be described elsewhere. All work indicated in the Mechanical Electrical Schedule shall be included in the Bid Price.

.3 The Mechanical Electrical Schedule shall not limit the extent of the Contract in any way. Work indicated elsewhere or otherwise needed for a complete and functioning installation shall be provided whether or not shown in the Mechanical Electrical Schedule.

1.2 RESPONSIBILITY CODES

.1 Responsibility Codes in the Mechanical Electrical Schedule shall be interpreted as follows:

.1 "Supplied by Div.": means that the equipment is to be supplied to the site under the Division described by number.

.2 "Installed by Div.": means that the equipment is to be received from the Supplier, handled, set in place and installed at the site under the Division described by number.

.3 "Wired and connected by Div.": means that the equipment and its associated devices are to be wired and connected to the various electrical systems in accordance with the equipment Manufacturer's installation instructions and wiring diagrams under the Division described by number.

2 Products

Not Used

3 Execution

3.1 MECHANICAL ELECTRICAL SCHEDULE

.1 Refer to the Mechanical Electrical Coordination Schedule.

END OF SECTION

MECHANICAL ELECTRICAL COORDINATION SCHEDULE

No.	Equipment				Controls			Responsibility		
	Item	Characteristics		Location	Type	Location	Manufacturer's Reference	Supplied by Div.	Installed by Div.	Wired and Connected by Div.
1	Electric Force Floor Heater [FF-1] (lot)	kW	2.3	Entry, Exit	Disconnect	At Panel		23	26	26
		Voltage	208		Comb. Starter			23	26	26
		Phases	1		Other Controls					
		Freq.	60		Integral Thermostat			23	23	-
2	Electric Cabinet Heater [CH-1] (lot)	kW	0.5	Office	Disconnect	At Panel		23	26	26
		Voltage	208		Comb. Starter					
		Phases	1		Other Controls					
		Freq.	60		Integral Thermostat			23	23	-
3	Electric Cabinet Heater [CH-2] (lot)	kW	1	Office	Disconnect	At Panel		23	26	26
		Voltage	208		Comb. Starter					
		Phases	1		Other Controls					
		Freq.	60		Integral Thermostat			23	23	-
4	Electric Cabinet Heater [CH-3] (lot)	kW	2	Office	Disconnect	At Panel		23	26	26
		Voltage	208		Comb. Starter					
		Phases	1		Other Controls					
		Freq.	60		Integral Thermostat			23	23	-
5	HVLS Destratification Fan [DF-1 to 4]	Watts	41.6	Vehicle Garage	Disconnect	At Panel		23	26	26
		Voltage	115		Comb. Starter	At Unit	VFD	23	23	26
		Phases	1		Other Controls	SenseMe		23	25	25
		Freq.	60		BAS			25	25	25
6	Rooftop Unit [RTU-1]	MCA	67.9	Ground	Disconnect	At Unit		26	26	26
		Voltage	208		Comb. Starter	VFD		23	23	23
		Phases	3		Other Controls	BAS		25	25	25
		Freq.	60							
7	Rooftop Unit [RTU-1] Convenience Outlet	Amp	20	Ground	Disconnect	At Panel		26	26	26
		Voltage	120		Comb. Starter					
		Phases	1		Other Controls					
		Freq.	60							
8	Rooftop Unit [RTU-2]	MCA	27.4	Ground	Disconnect	At Unit		26	26	26
		Voltage	208		Comb. Starter	VFD		23	23	23
		Phases	3		Other Controls	BAS		25	25	25
		Freq.	60							
9	Rooftop Unit [RTU-2] Convenience Outlet	Amp	20	Ground	Disconnect	At Panel		26	26	26
		Voltage	120		Comb. Starter					
		Phases	1		Other Controls					
		Freq.	60							
10	Electronic Trap Seal Primers [TSP] (lot)	Amps	-	as shown on plans	Disconnect	At Panel		26	26	26
		Voltage	120		Comb. Starter					
		Phases	1		Other Controls					
		Freq.	60							
11	VAV Boxes Electric Reheat Coils (lot with different capacities)			Office	Disconnect	At Panel		23	26	26
		Voltage	120		Comb. Starter			23	23	23
		Phases	1		Other Controls			23	23	23
		Freq.	60		120 v JB at each box					
12	Sump Pump [SP-1&2]	HP	6	Basement Sump Pit	Disconnect	At Panel		26	26	26
		Voltage	208		Comb. Starter					
		Phases	3		Other Controls	Duplex panel		23	23	23
		Freq.	60							

MECHANICAL ELECTRICAL COORDINATION SCHEDULE

No.	Equipment				Controls			Responsibility		
	Item	Characteristics		Location	Type	Location	Manufacturer's Reference	Supplied by Div.	Installed by Div.	Wired and Connected by Div.
13	Kitchen Exhaust Fan [KEF-1]	HP	0.5	Roof	Disconnect	At Panel		26	26	26
		Voltage	115		Comb. Starter					
		Phases	1		Other Controls			23	25	25
		Freq.	60		Interlocked with Hood Fire Sup. and MUA-1			26	26	26
14	Hood	Watt	200	Kitchen	Disconnect			26	26	26
		Voltage	115		Comb. Starter					
		Phases	1		Other Controls					
		Freq.	60							
15	Kitchen Makeup Air Unit [MUA-1]	MCA	3.7	Roof	Disconnect	At Panel		26	26	26
		Voltage	208		Comb. Starter					
		Phases	3		Other Controls			23	25	25
		Freq.	60		Interlocked with Hood Fire Sup. and KEF-1			26	26	26
16	Hood	Watt	200	Kitchen	Disconnect			26	26	26
		Voltage	115		Comb. Starter					
		Phases	1		Other Controls					
		Freq.	60							
17	Ductless Split System [AC-1], [AC-2]	MCA	0.4	Elec.Room	Disconnect	At Panel		26	26	26
		Voltage	208		Comb. Starter					
		Phases	1		Other Controls			23	25	25
		Freq.	60		Powered from CU-1			26	26	26
18	Air Cooled Condenser [CU-1]	MCA	30.2	Roof	Disconnect	At Unit		26	26	26
		Voltage	208		Comb. Starter					
		Phases	1		Other Controls					
		Freq.	60		AC-1 and AC-2 Interlocks			26	26	26
19										
20										
21										
22										
23										
24										

1 General

1.1 SUMMARY

.1 Pipe, fittings, valves, and connections for fire protection systems.

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 ASME Boiler and Pressure Vessel Code Section IX - Welding and Brazing Qualifications.
.2 ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
.3 ASME B16.3 - Malleable Iron Threaded Fittings.
.4 ASME B16.4 - Cast Iron Threaded Fittings.
.5 ASME B16.5 - Pipe Flanges and Flanged Fittings.
.6 ASME B16.9 - Factory-made Wrought Steel Butt Welding Fittings.
.7 ASME B16.11 - Forged Fittings Socket Welding and Threaded.
.8 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
.9 ASME B16.25 - Butt Welding Ends.
.10 ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
.11 ASTM A135 - Electric-Resistance-Welded Steel Pipe.
.12 ASTM A47/A47M - Ferritic Malleable Iron Castings.
.13 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.
.14 ASTM A234/A234M - Piping Fittings of Wrought-Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
.15 ASTM A795 - Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
.16 AWS A5.8 - Filler Metal for Brazing and Braze Welding.
.17 AWS D10.10 - Recommended Practices for Local Heating of Welds in Piping and Tubing.
.18 AWWA C110 - Ductile-Iron and Gray-Iron Fittings 3" (76 mm) through 48" (1219 mm) for Welder.
.19 AWWA C151 - Ductile Iron Pipe, Centrifugally Cast, for Water.
.20 NFPA 13 - Installation of Sprinkler Systems.
.21 NFPA 14 - Installation of Standpipe, Private Hydrants, and Hose Systems.
.22 NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances
.23 UL - Fire Resistance Directory.
.24 UL 262 - Gate Valves for Fire-Protection Service.
.25 UL 312 - Check Valves for Fire-Protection Service.
.26 UL 405 - Fire Department Connections.

1.4 SUBMITTALS

.1 Provide data on following components including Manufacturers catalogue information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- .1 Valves
- .2 Backflow preventers

1.5 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 3 years documented experience.

.2 Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years experience.

1.6 REGULATORY REQUIREMENTS

.1 Conform to OBC and OFC.

.2 Sprinkler Systems: Conform work to NFPA 13.

.3 Standpipe and Hose Systems: Conform to NFPA 14.

.4 Welding Materials and Procedures: Conform to ASME Code.

.5 Valves: Bear FM label or marking. Provide Manufacturer's name and pressure rating marked on valve body.

.6 Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.7 DELIVERY STORAGE AND PROTECTION

.1 Deliver and store valves in shipping containers, with labelling in place.

.2 Provide temporary protective coating on cast iron and steel valves.

.3 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.8 COOPERATION AND COORDINATION

.1 Work shall be performed in cooperation with the work of other trades and so scheduled as to allow efficient completion of the project.

.2 Furnish to other trades advance information on location and size of all concrete pads, chases, frames, boxes, sleeves, and openings needed for the work, and also furnish layout information and shop drawings necessary to permit other trades affected by the work to install their work properly coordinated and without delay.

.3 Where there is evidence that work installed interferes with the work of other trades, assist in working out space conditions to make satisfactory adjustments.

.4 With the acceptance of the Design Engineer and without extra cost to the Owner, make reasonable modifications in the work specified under this Section required

to coordinate with normal structural interferences and the proper execution of the specified work.

.5 If work is installed before coordinating with other trades so as to cause interference with the work of such trades, make all necessary changes in the work under this Section at no additional cost to the Owner.

.6 Protect all materials and work of other trades from damage that may be caused by the work of this Section and be responsible for repairing any damages caused by such work without any additional cost to the Owner.

.7 Follow Contract Drawings in the layout of the work. Check and coordinate with other trades to verify special provisions, installation requirements and spaces in which the work is to be installed. Maintain maximum headroom or space conditions at all points. Where headroom or space conditions appear inadequate, notify the Engineer and/or Project Manager prior to proceeding.

.8 Attend regular coordination and job progress meetings required.

2 Products

2.1 ABOVE GROUND PIPING

.1 For working pressures up to 300 psig (2,068 kPa), steel piping shall be Schedule 40 for 1” (25mm), no piping smaller than 1” (25mm) shall be permitted. Schedule 40 for sizes 1-1/4” (32mm) to 6” (150mm), and Schedule 40 for sizes 8” (200mm) and larger. Unless otherwise specified to be hot-dipped galvanized, pipe shall be black steel pipe and shall be pre-oxidized with a suitable protective coating.

.2 All empty piping that may be periodically filled with water including, but not limited to, drain piping, test piping, and fire department connection piping up to the check valve and piping from alarm check valve to water motor gong shall be hot dipped galvanized inside and out.

.3 Schedule 40 pipe 1” (25mm) to 2” (50mm) shall be joined by screwed joints in accordance with specification ASME B1.20.1.

.4 Schedule 30 and 40 pipe 1-1/4” (32mm) and larger shall be joined by either flanged joints, welded joints, or by mechanical couplings. For mechanical couplings, pipe ends shall have cut grooves. Roll grooving shall not be permitted.

.5 Schedule 10 pipe 1-1/4” (32mm) to 6” (150mm), and 8” (200mm) and 10” (250mm) pipe with 0.188” (4.78mm) minimum nominal wall thickness, shall be joined by welded joints in accordance with AWS D10.9 or by mechanical couplings. For mechanical couplings, pipe ends shall have rolled grooves. Cut grooving shall not be permitted. Piping shall not be threaded.

.6 Screwed fittings for working pressures up to 300 psig (2,068 kPa) shall be cast iron, class 125, black, and in accordance with ASME B16.4 or malleable iron, class 150, black, and in accordance with ASME B16.3.

.7 Welded fittings for working pressures up to 300 psig (2,068 kPa) shall be steel, standard weight, black, and in accordance with ASME B16.9 and ASME B16.11.

.8 Flanged fittings for working pressures up to 300 psig (2,068 kPa) shall be cast iron, short body, class 175 and in accordance with ASME B16.1 or B16.5, ASME B16.21, ASME B18.2.1, and ASME B18.2.2. Provide hexagon head machine bolts, hexagon head nuts, and washers, all heavy finished cadmium plated.

.9 Rubber gasketed grooved mechanical couplings and fittings shall be NFPA 14 listed and approved and consist of combination housings and gaskets. Housings shall either be malleable iron ASTM A47 or ductile iron ASTM A536 and shall be hot-dipped galvanized where galvanized piping is specified to be used. Gasket material shall be listed for the intended service and shall be Grade "E", EPDM. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same Manufacturer.

.10 Mechanical couplings shall be Victaulic Style 07 "Zero Flex" couplings for rigid connections in equipment rooms; Style 77 standard flexible couplings at pumps and vibration producing equipment; Style 77 at flexure points in equipment rooms and Style 75 at flexure points elsewhere (to meet seismic requirements); Style 72 outlet couplings; Style 750 reducers; and Style 741 "Vic-Flange" adapters at all valves and equipment connections.

.11 Victaulic "installation-ready" couplings may be substituted Style 107 for Style 07, and Style 177 for Styles 77 and 75.

.12 Expansion: When crossing building expansion or seismic joints, expansion or seismic loops, as required by NFPA 13, shall be installed with the appropriate couplings to allow for expansion in agreement with that as provided for by the building joint. Piping shall be securely anchored to the building structure on both sides of the building expansion and/or seismic joint.

2.2 PIPE HANGER AND SUPPORTS

.1 Conform to NFPA 13 and NFPA 14.

.2 Hangers for Pipe Sizes 1/2" to 1-1/2" (15 to 40mm): Carbon steel, adjustable swivel, split ring.

.3 Hangers for Pipe Sizes 2" (50mm) and Over: Carbon steel, adjustable, clevis.

.4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.5 Wall Support for Pipe Sizes to 3-1/4" (80mm): Cast iron hook.

.6 Wall Support for Pipe Sizes 4" (100mm) and Over: Welded steel bracket and wrought steel clamp.

.7 Vertical Support: Steel riser clamp.

.8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.3 VALVES – GENERAL

.1 CUL or ULC and FM approved, listed and labelled.

.2 All valves controlling connections to water supplies shall be listed indicating valves.

.3 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.

.4 Provide valves of the same Manufacturer where possible.

.5 Manufacturer's name and pressure rating clearly marked on body to MSS-SP-25.

.6 All valves supplied for this project shall have a current and valid Canadian Registration Number for the Province of Ontario with TSSA. Suppliers shall provide a copy of the Statutory Declaration for valves, stamped, signed and dated by TSSA as validation of the CRN registration. This shall be included with the shop drawing submittal package.

.7 Provide valves of types approved for fire service. Gate valves shall open by counter-clockwise rotation.

.1 Gate Valves 2” (50mm) and smaller shall be outside screw and yoke indicating type, bronze body, straightway pattern, screwed ends, 175 psig (1,207 kPa) working water pressure.

.2 Gate Valves 2-1/2” (65mm) and larger shall be outside screw and yoke indicating type, iron body, bronze mounted gate valves, straightway pattern, flanged ends, 175 psig (1,207 kPa) working water pressure.

.3 Butterfly Valves shall be an indicator type, built-in double pole/double throw tamper switch, 175 psig (1,207 kPa) working water pressure. Butterfly valves of sizes up to 6” (150mm) shall have locking type handles. Butterfly valves 8” (200mm) size shall have gear operators. Butterfly valves may be substituted for gate valves except where NFPA/Underwriter specifically requires an outside screw and yoke gate valve.

.4 Ball Valves 3” (75mm) and smaller shall be brass body, chrome plated brass ball with nylon seat, cadmium plated vinyl insulated handle, female NPT inlet and outlet, 600 psig (4,137 kPa) working water pressure.

.5 Check Valves 2” (50mm) and smaller shall be iron body, stainless steel trim, EPDM seal, screwed ends, silent check type, 200 psig (1,379 kPa) working water pressure.

.6 Check Valves 2-1/2” (65mm) and larger shall be iron body, bronze mounted, flanged ends, swing type for placement in the horizontal position, 175 psig (1,207 kPa) working water pressure. Provide flanged inspection and access cover plate for check valves 4” (100mm) and larger.

.7 Drain and Inspectors Test Valves shall be bronze globe valve with integral bronze seat, renewable disc, union bonnet, inside screw rising spindle, suitable for 300 psig (2,068 kPa) non-shock cold water.

.8 Backflow Preventer Test Valves: 2-1/2” (65mm) hose gate valve, iron body, bronze mounted, straightway or angle pattern, flanged end, 175 psig (1,207 kPa) working water pressure. Provide hose threads to suit local fire department with cap and chain.

.9 Automatic Ball Drip Valve: 3/4" (19mm), bronze body, corrosion resistant metal ball and spring, threaded ends, 175 psig (1,207 kPa) working water pressure.

.8 Design and Testing:

.1 Bronze Gate & Check valves: MSS-SP-80

.2 Cast Iron Gate Valves: MSS-SP-70

.3 Cast Iron Globe Valves: MSS-SP-85
.4 Cast Iron Check: MSS-SP-71
.5 Butterfly Valves: MSS-SP-67

.9 Acceptable Manufacturers:
.1 Kitz
.2 Crane, Jenkins
.3 Conbraco
.4 Nibco

2.4 BACKFLOW PREVENTERS

.1 Reduced pressure zone backflow preventers shall be CSA approved UL & FM listed and shall consist of two approved independent spring loaded check valves to provide drip tight closure with replaceable rubber faced discs and seats, stainless steel, body and internal parts, bolt-on access covers, complete with approved differential pressure relief valve with stainless steel trim. Assembly shall be complete with two approved OS & Y flanged gate valve shutoffs and Manufacturer supplied screw on air gap/drain cone. Entire assembly shall be furnished with four factory mounted bronze ball valve test cocks. Assembly shall be Watts Series 957.

.2 Alternative Manufacturers – Ames, Conbraco, Febco, Wilkins.

3 Execution

3.1 SEQUENCE OF APPROVALS

.1 Prepare sufficient copies of fabrication and installation shop drawings. Submit in sequence to:
.1 Local Fire Department; and then
.2 Consultant for review.

.2 NO WORK ON SYSTEM(S) INSTALLATION SHALL COMMENCE UNTIL AFTER WORKING PLANS ARE REVIEWED BY ALL THE ABOVE PARTIES, UNLESS PERMISSION IN WRITING IS RECEIVED FROM BOTH OWNER AND CONSULTANT. EXPEDITE PRODUCTION OF SHOP DRAWINGS AS SOON AS POSSIBLE AND IMMEDIATELY AFTER AWARD OF CONTRACT.

.3 After the reviews have been performed, make all required changes to the final fabrication drawings. Forward written confirmation to the Consultant that all review information has been incorporated and forwarded to the site for installations.

3.2 PREPARATION

.1 Ream pipe and tube ends. Remove burrs.

.2 Remove scale and foreign material, from inside and outside, before assembly.

3.3 INSTALLATION

.1 Install piping to NFPA 13 for sprinkler systems.

.2 Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

.3 Install piping to conserve building space, to not interfere with use of space and other work.

.4 Group piping whenever practical at common elevations.

.5 Sleeve pipes passing through partitions, walls, and floors.

.6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

.7 Inserts:
- .1 Provide inserts for placement in concrete formwork.
- .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 100mm.
- .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- .5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

.8 Pipe Hangers and Supports:
- .1 Install to NFPA standards.
- .2 Install hangers to provide minimum 1/2" (13mm) space between finished covering and adjacent work.
- .3 Place hangers within 12" (300mm) of each horizontal elbow.
- .4 Use hangers with 1-1/2" (38mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- .5 Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
- .6 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

.9 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

.10 Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding, maximum VOC content of 250g/L.

.11 Do not penetrate building structural members unless indicated.

.12 Provide sleeves when penetrating footings. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.

.13 When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

.14 Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

.15 Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.

.16 Provide ball valves for shut-off or isolating service.

.17 Provide drain valves at main shut-off valves, low points of piping and apparatus.

.18 All control, drain and test connection valves shall be provided with permanently engraved and marked weatherproof metal or rigid plastic identification signs, secured with weather resistant chain or other approved method.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 Comply with the General Requirements of Section 20 01 00 and the Common Work Section 20 05 00.

.2 Read and conform to:
- .1 The Contract CCDC 2, Stipulated Price Contract as amended in the Contract Documents;
- .2 Division 01 requirements and documents referred to therein.

1.2 SECTION INCLUDES

.1 Standpipe network
.2 Fire hose cabinets
.3 Fire department connections
.4 Air Compressors
.5 Alarm Valves.

1.3 REFERENCES

.1 Refer to the latest edition of the following:
- .1 ASME B1.20.1: Pipe Threads, General Purpose.
- .2 ASME B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.
- .3 ASME B16.3: Malleable Iron Threaded Fittings.
- .4 ASME B16.4: Cast Iron Threaded Fittings.
- .5 ASME B16.15: Pipe Flanges and Flanged Fittings.
- .6 ASME B16.9: Factory-Made Wrought Steel Butt- Welding Fittings.
- .7 ASME B16.11: Forged Fittings, Socket-Welding and Threaded.
- .8 ASME B16.21: Non-Metallic Flat Gaskets for Pipe Flanges.
- .9 ASME B18.2.1: Square and Hex Bolts and Screws.
- .10 ASME B18.2.2: Square and Hex Nuts.
- .11 ASME B31.1: Power Piping.
- .12 ASME B40.1: Gauges - Pressure Indicating Dial Type.
- .13 ASME BPV X: Boiler Pressure Vessel Code – Welding and Brazing Qualifications.
- .14 ASSE 1013: Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
- .15 ASSE 1015: Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies.
- .16 ASTM A36: Carbon Structural Steel.
- .17 ASTM A47: Malleable Iron Castings.
- .18 ASTM A53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- .19 ASTM A536: Ductile Iron Castings.
- .20 ASTM A795: Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
- .21 ASTM 1048: Double Check Detector Fire Protection Backflow Prevention Assemblies.

.22 AWS D10.9: Qualification of Welding Procedures and Welders for Piping and Tubing.
.23 AWWA C104: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
.24 AWWA C105: Polyethylene Encasement for Ductile-Iron Pipe Systems.
.25 AWWA C111: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
.26 AWWA C151: Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
.27 AWWA C500: Metal Seated Gate Valves for Water Supply Source.
.28 AWWA C651: Disinfecting Water Mains.
.29 FM - Factory Mutual Approval Guide.
.30 MSS SP-58: Pipe Hangers and Supports - Materials, Design and Manufacture.
.31 NFPA 10: Portable Fire Extinguishers.
.32 NFPA 13: Installation of Sprinkler Systems.
.33 NFPA 14: Installation of Standpipe, Private Hydrants, and Hose Systems.
.34 NFPA 20: Standard for the Installation of Centrifugal Fire Pumps.
.35 NFPA 24: Installation of Private Fire Service Mains and Their Appurtenances.
.36 NFPA 25: Inspection, Testing, and Maintenance of Water Based Fire Protection Systems.
.37 NFPA 26 - Supervision of Valves Controlling Water Supplies.
.38 NFPA 72 - Installation, Maintenance and Use of Protective Signalling Systems.
.39 NFPA 291: Fire Flow Testing and Marking of Hydrants.
.40 ULC - Fire Protection Equipment Directory.
.41 ITS (Intertek Testing Services) - Certification Listings.

1.4 SUBMITTALS

.1 Product Data.
.1 Provide Manufacturer's catalogue data for equipment indicating model, type, size, capacity, curves, wiring diagrams, finish, and accessories of each item.

.2 Shop Drawings:
.1 Indicate valves, piping system, supports, components, accessories, and sizes. Submit shop drawings and product data to Owner's insurance underwriter for approval. Submit proof of approval to Consultant.
.2 Prepare computer generated hydraulic calculations in accordance with NFPA 14 to substantiate compliance with hydraulic design requirements. Submit name of software program utilized. Submit hydraulic calculations stamped and signed by an Engineer licensed in the jurisdiction the work is to be performed.
.3 Provide hydrant flow test data, less than 1 year old conforming to NFPA 291. In case of a winter test, provide comparison to local water department tests or estimates of minimum summer flow and pressure for basis of design. The lesser combined flow and pressure test results shall be used for the hydraulic design of the system.

.3 Project Record Documents: Record actual locations of components.

.4 Operation Data: Include Manufacturer's data.

.5 Maintenance Data: Include servicing requirements and test schedule.

.1 Certificates: Provide certificate of compliance from authority having jurisdiction indicating approval of field acceptance tests.

1.5 QUALITY ASSURANCE

.1 Perform work in accordance NFPA 14. Maintain one copy on-site.

.2 Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years documented experience.

.3 Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum 3 years documented experience.

.4 Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed at the place where the project is located.

.5 Tests shall be conducted in presence of the authorities having jurisdiction. Contractor shall notify the authorities having jurisdiction and the Engineer a minimum 5 days prior to performing tests.

1.6 REGULATORY REQUIREMENTS

.1 Conform to the Ontario Building Code, Ontario Fire Code and ULC.

.2 Perform work in accordance with NFPA 13 and NFPA 14.

.3 Equipment and Components shall bear the ULC and FM label or marking.

.4 Products Requiring Electrical Connection shall be CSA Listed and classified by Underwriters Laboratories of Canada Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE AND PROTECTION

.1 All equipment, material and spare parts shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Contractor.

.2 All equipment, material and spare parts shall be delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.

.3 Store equipment, material and spare parts protected from the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 EXTRA MATERIAL

.1 Provide two of each hose nozzle type.

2 Products

2.1 FIRE HOSE CABINETS (FHC)

.1 Manufacturer:
- .1 National Fire Equipment Ltd.
- .2 Elkhart Fire Equipment
- .3 Wilson Cousins
- .4 CEB

.2 Hose Cabinets:
- .1 Surface mounted.
  - .1 Constructed from 18 gauge (1.19mm) gray baked grey enamel corrosion protected steel tubs and a 14 gauge (2.0mm) gray baked enamel corrosion protected steel door and frame with hollow channel reinforcement. The frame section can be site adjusted for left or right door swing. Complete with full-length semi-concealed piano hinges, flush stainless steel door catch, and full panel of 1/4" (6mm) safety glass.
    - .1 Single valve (1-1/2” (32mm)): Model CS-400.
    - .2 Two valve (1-1/2” (32mm) and 2-1/2” (65mm)): Model CS-200.
    - .3 Single valve with extinguisher: Model CS-800-6.
    - .4 Two valve with extinguisher: Model CS-800.
- .2 Recessed
  - .1 Constructed from 18 gauge (1.19mm) baked white enamel corrosion protected steel tubs with a 14 gauge (2.0mm) gray baked enamel corrosion protectiod steel door and frame with hollow channel reinforcement. Front section to have a 2” (50mm) adjustment to wall surface and be complete with a 1/2" (13mm) turn back frame. Cabinet shall include a full length semi-concealed piano hinge, flush stainless steel door latch and full panel 1/4" (6mm) safety glass. Stainless steel fronts shall include three fully concealed hinges.
    - .1 Single valve (1-1/2” (32mm)): Model CK-1001.
    - .2 Two valve (1-1/2” (32mm) and 2-1/2” (65mm)): Model CK-2001.
    - .3 Single valve with extinguisher: Model CK-1002-6.
    - .4 Two valve with extinguisher: Model CK-2002.

.3 Hose Rack: National Fire Equipment Ltd., Model HR-1 Semi-Automatic Hose Rack, positive water stop, steel body with red powder coat swing rack, paint, zinc plated corrosion resistant pins, nozzle clip holder and protective cover.

.4 Hose: National Fire Equipment Ltd., Model BICO; 38mm (1-1/2”) diameter, 30m (100’-0”) long, double jacket, polyester spun as warp and filament polyester as weft/filler, EPDM inner liner, and white in colour.

.5 Nozzle: National Fire Equipment Ltd., Model A7BP – 38mm (1-1/2") diameter, red lexan polycarbonate, FM, UL, ULC.

2.2 VALVES

.1 Hose Station Valve: National Fire Equipment Ltd., Model A50; angle type, forged brass body with red hand wheel, 38mm (1-1/2") nominal size with hydrovent.

.2 Hose Connection Valve: National Fire Equipment Ltd., Model A56 angle type; forged brass body with red hand wheel; 65mm (2-1/2") size, thread to match fire department hardware, 2,070 kPa (300 psi) working pressure, with threaded cap and chain of same material and finish.

.3 Pressure Reducing Valve: National Fire Equipment Ltd., Model A155S, angle type; forged brass body with red hand wheel, inner hydraulic controls; 38mm (1-1/2") size, thread to match fire department hardware, 2,760 kPa (400 psi) inlet pressure.

2.3 PIPING SPECIALTIES

.1 Manufacturers:
- .1 Tyco – Central.
- .2 Tyco – Grinnel (GEM).
- .3 Viking.
- .4 Reliable.

.2 Dry Pipe Alarm Valve: TYCO Model DPV-1, Check type valve with divided seat ring, rubber faced clapper to automatically actuate electric alarm, with pressure retard chamber and variable pressure trim; with test and drain valve.

.3 Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC. .

.4 Supervisory Switches: As manufactured by Potter.

2.4 AIR COMPRESSOR

.1 Manufacturer: DeVilbiss SDI Series.

.2 Other acceptable Manufacturers: refer to Section 01 25 16.

.3 CSA listed, ULC and FM approved.

.4 Piston type compressor, floor mounted complete with either a horizontal or vertical air receiver, all necessary piping, accessories, devices and vibration isolation.

.5 Compressor shall be sized to bring system up to pressure within 30 minutes and controlled by manual on-off switch.

.6 Provide complete with starter and disconnect.

.7 Air supply shall be regulated, restricted and maintained automatically.

2.5 FIRE DEPARTMENT SIAMESE CONNECTION

.1 Wall Mounted.
- .1 National Fire Equipment Ltd., Model 201, double inlet Fire Department connection with 500 gpm (31.5 LPS) inlet capacity, complete with cast brass body with red aluminum plate and caps, rated pressure 300 psi (2,068 kPa), single swing clapper, two 2-1/2” (65mm) swivel hose thread

inlets complete with brass plugs. Base shall be 4” (100mm) female NPT. Optional finishes polished chrome.

.2 Label: "Standpipe - Fire Department Connection".

.2 Flush Mounted.

.1 National Fire Equipment Ltd., Model 229, double inlet Fire Department connection with 500 gpm (31.5 LPS) inlet capacity rated pressure 300 psi (2,068 kPa), complete with cast brass straight or angle body, brass plate, brass swivel adapters and brass plugs. Ass exposed services standard with polished finish. Assembly shall include an angle body. Base shall be 4” (100mm) female NPT.

.2 Optional:

.1 Plate and Plugs: polished chrome.

.2 Plate: polished stainless steel with engraved lettering.

.3 Label: "Standpipe - Fire Department Connection".

.3 Free Standing.

.1 National Fire Equipment Ltd., Model 207, brass body, red aluminium escutcheon plate, red aluminium break-off caps,457mm (18”) polished brass cover sleeve.

.2 Type: Free standing type with brass finish.

.3 Outlets: Two way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.

.4 Label: "Standpipe - Fire Department Connection".

3 Execution

3.1 INSTALLATION

.1 Install to Manufacturer's instructions.

.2 Install to Ontario Building Code, NFPA 13 and 14 and to local authorities requirements.

.3 Install aboveground piping to permit draining of all sections of each piping systems without traps. Pitch piping back to system low points. Provide drain valves at all piping low points.

.4 Buried Piping

.1 Pipe bedding and compacted backfill to a point 12” (300mm) above crown of buried pipe shall be provided under this Section.

.2 Pipe bedding shall be 6” (150mm) deep. Bedding and compacted backfill shall be non-corrosive material such as cleaned, washed sand.

.3 Install buried lines in a single trench. Trenches shall be wide enough to permit at least 6” (150mm) spacing between lines and the sides and floor of the trench.

.4 Terminate buried piping not more than 12” (300mm) finished floor slab-on-grade or 6” (150mm) above finished grade.

.5 Completely encase buried piping with polyethylene tube or sheet in accordance with AWWA C105.

.6 Bury utility warning and identification tape with the printed side up at a depth of 12” (300mm) below the top surface of earth or the top surface of the subgrade under pavements.

.5 Provide approved reduced pressure principle backflow preventer assembly at water source connection Locate and secure cabinets plumb and level.

.6 Establish top of cabinet (inside horizontal surface) 1,525mm (60") above finished floor.

.7 Locate hose station valve in cabinet at 1,375mm (54") above floor. Locate hose connection valve below hose station valve and not closer than 100mm 4" (100 mm) from side or bottom of cabinet.

.8 Locate portable fire extinguisher in cabinet.

.9 Connect standpipe system to water source ahead of domestic water connection as indicated in the schematic.

.10 Furnish pipe sleeves where piping passes through walls, floors, ceilings, roofs, and partitions. Furnish sleeves of sufficient length to pass through entire thickness of walls, floors, ceilings, roofs, and partitions. Provide not less than 1/4" (6mm) space between uninsulated pipe and sleeve and 1” (25mm) space between pipe insulation and sleeve. Firmly pack space with mineral wool insulation. For non-fire rated assemblies, seal at both ends of the sleeve with caulking as specified in Division 07. Seal both ends of penetrations through fire rated assemblies to maintain fire resistance rating of the assembly penetrated.

.11 Extend sleeves in floor slabs 2” (50mm) above the finished floor.

.12 Install air compressor on vibration isolators.

.13 Where static pressure exceeds 690 kPa (100 psi) but is less than 690 kPa (100 psi) at any hose station, provide pressure orifice disc in discharge of hose station valve to prevent pressure on hose exceeding 690 kPa (100 psi).

.14 Where static pressure exceeds 690 kPa (100 psi) at any hose station, provide pressure reducing valve to prevent pressure on hose exceeding 620 kPa (90 psi).

.15 Provide two way fire department outlet connection where indicated on the Drawings.

.16 Flush entire system of foreign matter.

3.2 FIELD QUALITY CONTROL

.1 Test entire system to NFPA 14.

.2 Test shall be witnessed by authority having jurisdiction.

.3 Arrange and pay for all reviews and inspections required by:
- .1 Local Inspection Authority.
- .2 Owner's Insurance Authority.

.4 Coordinate testing of standpipe systems with fire alarm system verification to ensure that all devices are fully tested.

END OF SECTION

1 General

1.1 SUMMARY

.1 Pipe, pipe fittings, valves, and connections for piping systems.
- .1 Storm drainage
- .2 Sanitary drainage
- .3 Sanitary vent
- .4 Potable water

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
.2 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
.3 ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
.4 ASME B16.26 - Copper Alloy Bronze Fittings for Flared Copper Tubes.
.5 ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
.6 ASME B16.32 - Cast Copper Alloy Solder Joint Fittings for Solvent Drainage Systems.
.7 ASTM A74 - Cast Iron Soil Pipe and Fittings.
.8 ASTM B32 - Solder Metal.
.9 ASTM B42 - Seamless Copper Pipe, Standard Sizes.
.10 ASTM B68 - Seamless Copper Tube, Bright Annealed.
.11 ASTM B75 - Seamless Copper Tube.
.12 ASTM B88 - Seamless Copper Water Tube.
.13 ASTM B251 - General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
.14 ASTM B302 – Thread-less Copper Pipe, Standard Sizes.
.15 ASTM B306 - Copper Drainage Tube (DWV).
.16 ASTM C1053 - Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications.
.17 ASTM D2235 - Solvent Cement for Acrylonitrile - Butadiene - Styrene (ABS) Plastic Pipe and Fittings.
.18 ASTM D2239 - Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
.19 ASTM D2241 - Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
.20 ASTM D2447 - Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.
.21 ASTM D2466 - Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
.22 ASTM D2564 - Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
.23 ASTM D2661 - Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.

.24 ASTM D2665 - Polyvinyl Chloride (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
.25 ASTM D2729 - Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
.26 ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer, Pipe, and Fittings.
.27 ASTM D2846 - Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cements and Adhesives for Potable Hot Water Systems.
.28 ASTM D2855 - Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings.
.29 ASTM D3034 - Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
.30 ASTM E814 - Fire Tests of Through-Penetration Fire Stops.
.31 ASTM F679 - Polyvinyl Chloride (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
.32 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
.33 AWWA C110 - Ductile - Iron and Gray - Iron Fittings, 3" - 48" (75mm - 1200mm), for Water.
.34 AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
.35 AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water.
.36 AWWA C651 - Disinfecting Water Mains.
.37 AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe (and Fabricated Fittings), 4" - 12" (100mm – 300mm), for Water Distribution.
.38 AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2" - 3" (13mm – 75mm) for Water Service.
.39 AWWA C902 - Polybutylene (PB) Pressure Pipe and Tubing, 1/2" - 3" (13mm – 75mm) for Water.
.40 AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14" - 48" (350mm – 1200mm).
.41 CISPI 301 - Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
.42 CISPI 310 - Joints with Hub-less Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
.43 MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
.44 MSS SP69 - Pipe Hangers and Supports - Selection and Application.
.45 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.4 SUBMITTALS

.1 Submit a ‘Letter of Conformance’, indicating specified items selected for use in the project with the following supporting product data and reports.

.2 Provide data on valves, and accessories. Provide Manufacturers catalogue information. Indicate valve data and ratings.

.3 Record actual locations of valves.

1.5 QUALITY ASSURANCE

.1 Perform Work to Province of Ontario standards. Maintain one copy on-site.

.2 Identify pipe with marking including size, ASTM material classification, ASTM Specification, potable water certification, water pressure rating.

1.6 REGULATORY REQUIREMENTS

.1 Perform Work to Province of Ontario plumbing code.

.2 Conform to applicable code for installation of backflow prevention devices.

.3 Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.7 DELIVERY, STORAGE AND PROTECTION

.1 Accept valves on site in shipping containers with labelling in place. Inspect for damage.

.2 Provide temporary protective coating on cast iron and steel valves.

.3 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

.4 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Do not install underground piping when bedding is wet or frozen.

2 Products

2.1 SANITARY WASTE AND VENT PIPING - BURIED

.1 Sizes up to 2-1/2” (65mm).
- .1 ABS-DWV pipe ASTM D2751 or ASTM F628 with ABS fittings and solvent welded (ASTM D2235) joints.
- .2 PVC-DWV pipe to CSA B181.2 with PVC fittings and solvent welded joints.

.2 Sizes 3” (75mm) and larger.
- .1 PVC-DWV pipe to CSA B181.2 with PVC fittings and solvent welded joints.

2.2 SANITARY WASTE AND VENT PIPING - ABOVEGROUND

.1 Sizes up to 2-1/2” (65mm).
- .1 Copper tube ASTM B306, DWV seamless copper tube with cast bronze (ASME B16.23) or wrought copper (ASME B16.29) fittings and 95/5 soldered joints (ASTM B32). Excluding fixture drain connections.

.2 Sizes 3” (75mm) and larger.
- .1 Cast iron soil pipe (CISPI 301) hub-less with cast iron fittings and joints (CISPI 310) with neoprene gasket, stainless steel clamp and shield.

2.3 STORM DRAINAGE PIPING - ABOVEGROUND

.1 Sizes 3” (75mm) and larger.
- .1 Cast iron soil pipe (CISPI 301) hub-less with cast iron fittings and joints (CISPI 310) with neoprene gasket, stainless steel clamp and shield.

.2 PVC Pipe (exposed locations) Ipex Inc. System 15 rigid PVC drain, waste, and vent pipe and fittings manufactured to CAN/CSA B181.2, complete with solvent weld joints. Solvent weld cement and primer (when required by Manufacture) shall be same Manufacturer as pipe. When used in buildings of non-combustible construction all PVC pipes shall be certified to CAN/ULC S102.2 and achieve a Flame Spread Rating not exceeding 25. System 15 shall not be used in high buildings or air plenums. For dry fire barrier penetration, an approved donut type firestop conforming to the requirements of ULC/CAN4-S115 M95 shall be installed at all fire rated walls.

.1 Acceptable Manufacturers

.1 Ipex “System 15” DWV Pipe

.2 Royal Building Products “LRS-25” DWV Pipe

.3 PVC Pipe (Plenum Rated): Ipex Inc. System XFR rigid PVC drain, waste, and vent pipe and fittings to CAN/CSA B181.2, complete with solvent weld joints. Solvent weld cement and primer (when required by Manufacture) shall be same Manufacturer as pipe. When used in buildings of non-combustible construction, high buildings, and air plenums all PVC pipes shall be certified to CAN/ULC S102.2, achieve a Flame Spread Rating not exceeding 25 and achieve Smoke Developed Classification not exceeding 50. For dry fire barrier penetration, an approved donut type firestop conforming to the requirements of ULC/CAN4-S115 M95 shall be installed at all fire rated walls.

.1 Acceptable Manufacturers

.1 Ipex “XFR” DWV Pipe

.2 Royal Building Products “HRS-2550” DWV Pipe

2.4 WATER PIPING - ABOVEGROUND

.1 All Sizes.

.1 Type `L', ASTM B88 hard drawn copper tube with cast copper alloy (ASME B16.18) or wrought copper and bronze (ASME B16.22) fittings and couplings and 95/5 soldered joints.

2.5 FLANGES, UNIONS AND COUPLINGS

.1 Pipe Size up to 3" (75mm):

.1 Ferrous pipe: Class 150 psi (1,033 kPa) malleable iron threaded unions.

.2 Copper tube and pipe: Class 150 psi (1,033 kPa) bronze unions with soldered joints.

.2 Pipe Size over 4" (100mm):

.1 Ferrous pipe: Class 150 psi (1,033 kPa) forged steel slip-on flanges; preformed 1/16” (1.5mm) thick neoprene gaskets.

.2 Copper tube and pipe: Class 150 psi (1,033 kPa) slip-on bronze flanges; preformed 1/16” (1.5mm) thick neoprene gaskets.

.3 Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.6 VALVES – GENERAL

.1 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.

.2 Provide valves of the same Manufacturer where possible.

.3 Manufacturer's name and pressure rating clearly marked on body to MSS-SP-25.

.4 Valid CRN (Canadian Registration Number) issued by Province of Ontario required for each valve.

.5 Materials:
- .1 Bronze: ASTM B62 or B61 as applicable
- .2 Brass: ASTM B283 C3770
- .3 Cast Iron: ASTM A126 Class B

.6 End Connections:
- .1 Flanged ends: ANSI B16.1 (Class 125), ANSI B16.5
- .2 Face-to-face dimensions: ANSI B16.10

.7 Design and Testing:
- .1 Bronze Gate & Check valves: MSS-SP-80
- .2 Ball Valves: MSS-SP-110
- .3 Cast Iron Gate Valves: MSS-SP-70
- .4 Cast Iron Globe Valves: MSS-SP-85
- .5 Cast Iron Check: MSS-SP-71
- .6 Butterfly Valves: MSS-SP-67
- .7 First named product as indicated in paragraphs below; other acceptable Manufacturers, subject to shop drawing review.

2.7 ISOLATION VALVES

.1 Sizes up to 50mm (2"):
- .1 Construction: MSS SP-110, 2 piece full port forged brass ball valve, cold working pressure 600 psig (4,140 kPa), threaded or soldered ends, PTFE seats, brass stem, chrome plated ball. Valves in insulated piping, provide a 2” (50mm) stem extension and extended operating handle of non-thermal conductive material, and protective sleeve that allows operation of valve without breaking the vapour seal or disturbing insulation.
- .2 Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - .1 Jenkins.
  - .2 Kitz Corporation.
  - .3 Watts Regulator.

.2 Sizes 65mm (2 1/2") and larger:
- .1 Construction: MSS SP-70, gate valve with rising stem, cold working pressure 200 psig (1,380 kPa), ASTM A126 gray iron body with bolted bonnet and flanged ends, bronze trim, solid wedge disc and asbestos free packing and gasket.
- .2 Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - .1 Jenkins.
  - .2 Kitz Corporation.

.3 Watts Regulator.

2.8 BALANCING VALVES

.1 Sizes up to 50mm (2"):
- .1 Construction: MSS SP-80, cold working pressure 300 psig (2,070 kPa) with a bronze body with integral seat and union ring bonnet to ASTM B62, soldered or threaded ends, bronze stem, PTFE disc, asbestos free packing and either a malleable iron, bronze, or aluminium hand wheel.
- .2 Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - .1 Jenkins.
  - .2 Kitz Corporation.
  - .3 Watts Regulator.

2.9 CHECK VALVES

.1 Sizes up to 50mm (2"):
- .1 Construction: MSS SP-80, cold working pressure 300 psig (2,070 kPa) with an ASTM B62 bronze body swing check with horizontal flow, threaded or soldered ends, and bronze disc.
- .2 Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - .1 Jenkins.
  - .2 Watts Regulator.

2.10 DRAIN VALVES

.1 Shut-off, for drips and drains, Crane/Jenkins model 901CJ complete with adaptor, 1400 kPa (200 psi); cold working pressure, bronze body, hose outlet, and threaded inlet, complete with 658 cap and chain.

2.11 RELIEF VALVES

.1 ASME rated, Wilkins Series P220 or Watts Series 3L pressure type, Wilkins Series TP220 or Watts Series 40 temperature and pressure type, relief valve with bronze body, bolted cap, non-metallic disc to metal seating, with elevated seat design, test lever and extended copper sheathed (thermostat) release mechanism.

3 Execution

3.1 EXAMINATION

.1 Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

.1 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

.2 Remove scale and dirt, on inside and outside, before assembly.

.3 Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

.1 Install to Manufacturer's instructions.

.2 Provide non-conducting dielectric connections wherever jointing dissimilar metals.

.3 Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

.4 Install piping to maintain headroom, conserve space, and not interfere with use of space.

.5 Group piping whenever practical at common elevations.

.6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

.7 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

.8 Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with general trades.

.9 Establish elevations of buried piping outside the building to ensure not less than 4' (1.2m) of cover.

.10 Install vent piping penetrating roofed areas to maintain integrity of roof assembly; refer to Division 07.

.11 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer (maximum VOC content of 80 g/L) to welding.

.12 Provide support for utility meters to requirements of utility companies.

.13 Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting where required. Coordinate with general trades.

.14 Excavate and backfill as required for work of this Section.

.15 Install bell and spigot pipe with bell end upstream.

.16 Install valves with stems upright or horizontal, not inverted.

.17 Pipe vents from gas pressure reducing valves to outdoors and terminate in weatherproof hood.

.18 Sleeve pipes passing through partitions, walls and floors.

.19 Inserts:

- .1 Provide inserts for placement in concrete formwork.
- .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4" (100mm).
- .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- .5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

.20 Pipe Hangers and Supports:

.1 Install to OBC.

.2 Support horizontal piping as scheduled.

.3 Install hangers to provide minimum 1/2" (13mm) space between finished covering and adjacent work.

.4 Place hangers within 12" (300mm) of each horizontal elbow.

.5 Use hangers with 1-1/2" (38mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

.6 Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.

.7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

.8 Provide copper plated hangers and supports for copper piping.

.9 Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

.10 Provide hangers adjacent to motor driven equipment with vibration isolation.

.11 Support cast iron drainage piping at every joint.

3.4 APPLICATION

.1 Install unions downstream of valves and at equipment or apparatus connections.

.2 Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

.3 Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

.4 Install globe valves for throttling, bypass, or manual flow control services.

.5 Provide spring loaded check valves on discharge of water pumps.

.6 Provide plug valves in natural gas systems for shut-off service.

.7 Provide flow controls in water re-circulating systems where indicated.

3.5 ERECTION TOLERANCES

.1 Establish invert elevations, slopes for drainage to 2% minimum. Maintain gradients.

.2 Slope water piping minimum 0.25% and arrange to drain at low points.

3.6 DISINFECTION OF POTABLE WATER PIPING

.1 Disinfect water distribution system.

.2 Prior to starting work, verify system is complete, flushed and clean.

.3 Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

.4 Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

.5 Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15% of outlets.

.6 Maintain disinfectant in system for 24 hours.

.7 If final disinfectant residual tests less than 25 mg/L, repeat treatment.

.8 Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

.9 Take samples no sooner than 24 hours after flushing, from 10% of outlets and from water entry, and analyze to AWWA C651.

3.7 SERVICE CONNECTIONS

.1 Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

.2 Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves pressure reducing valve.

.3 Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 1.75 kPa. Provide regulators on each line serving gravity type appliances, sized to equipment.

END OF SECTION

1 General

1.1 SUMMARY

.1 Floor Drains
.2 Roof Drains
.3 Cleanouts
.4 Hose bibs
.5 Hydrants
.6 Hose racks
.7 Backflow preventers
.8 Check valves
.9 Water hammer arrestors
.10 Potable hot water automatic flow limiting and balancing valves
.11 Partition stops
.12 Mixing valves
.13 Thermostatic mixing valves
.14 Trap Seal Primers

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 ASME A112.21.1 - Floor Drains.
.2 ASME A112.6.4 - Roof, Deck, and Balcony Drains.
.3 ASME A112.26.1 - Water Hammer Arrestors.
.4 ASSE 1011 - Hose Connection Vacuum Breakers.
.5 ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
.6 ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.
.7 AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.
.8 PDI WH-201 - Water Hammer Arrestors.

1.4 SUBMITTALS

.1 Submit shop drawings for each plumbing specialty.

1.5 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years documented experience.

.2 Provide listing/approval stamp, label or other marking on plumbing specialties are made to the specified standard(s).

1.6 DELIVERY, STORAGE AND PROTECTION

.1 Accept specialties on-site in original factory packaging. Inspect for damage.

2 Products

2.1 GENERAL

.1 Manufacturer: Watts Drainage model indicated or equivalent by:
- .1 Zurn
- .2 Jay R. Smith
- .3 Precision Plumbing Products
- .4 Lawler
- .5 Febco

2.2 FLOOR DRAINS

.1 Floor Drain (FD):
- .1 Manufacturer: Watts Drainage model FD-100-C-A5-1-5
- .2 Epoxy coated cast iron floor drain with anchor flange, reversible membrane clamp with primary and secondary weep hole, 1/4" (9mm) thick 5” (125mm) adjustable nickel bronze strainer grate, trap seal primer connection and no hub outlet.
- .3 Accessories:
  - .1 Sediment bucket.

.2 Funnel Floor Drain (FFD):
- .1 Manufacturer: Watts Drainage Model FD-100-C-EG-1-5
- .2 Epoxy coated cast iron floor drain with anchor flange, reversible membrane clamp with primary and secondary weep holes, 1/4" (6mm) thick 5” (125mm) adjustable nickel bronze strainer, 4” x 9” (100 x 225mm) oval nickel bronze funnel, trap seal primer connection and no hub outlet
- .3 Accessories:
  - .1 Sediment bucket.

.3 Area Drain (AD):
- .1 Manufacturer: Watts Drainage Model FS-504
- .2 PVC body, 6" (152mm) deep, 12" x 12" (305mm x 305mm), secured, 4"Ø (102mm), socket outlet.

2.3 ROOF DRAINS

.1 Roof Drains (RD-1)
- .1 Mifab R1200-6-M-B-U-V,
- .2 Roof drains in metal decks shall be coated cast iron body, large sump, wide non-crimping flange, vandal proof aluminum or ductile iron mushroom dome strainer, extension frame to suit thickness of insulation, sump receiver, under-deck clamps and flashing clamp with integral gravel stop.
- .3 Roof drains in I.R.M.A. or upside-down roofs shall be similar to drains specified above but with cast extensions to suit full depth of gravel and/or pavers and insulation and cast slotted surround for full depth of gravel and insulation for all openings larger than 12mm (1/2”)
- .4 Provide screens as required to prevent gravel from entering the drain pipes.
- .5 Provide vertical expansion joint, Mifab R1900.

.2 Roof Drains suitable for gutters (RD-2)
- .1 Mifab, 1100
- .2 Lacquered cast iron roof drain with anchor flange, cast iron waterproofing membrane clamp ring with integral gravel stop, and standard self-locking polyethylene dome strainer.
- .3 8” (2003mm) diameter body is ideal for applications with limited space.

2.4 TRAP SEAL PRIMERS [TSP]

.1 Individual Trap
- .1 Manufacturer: Watts Drainage Model MS-810
- .2 All brass trap seal primer with integral vacuum breaker, 1/2” (13mm) copper sweat inlet and outlet connection and 1/2” (13mm) IPS drip line connection.

.2 Flush Valve
- .1 Manufacturer: Precision Plumbing Products FVP-1VB
- .2 Lead free cast brass body, activated during flush valve operation, 3oz (0.09 L) of water will flow through priming tube to floor drain trap, flush valve primer should always be installed with vacuum breaker.

.3 Electronic Type
- .1 Activated by a 3/4" (19mm) normally closed solenoid valve, designed to interface with low voltage energy management systems control, 3/4" (19mm) diameter connection anti-siphon atmospheric vacuum breaker.
- .2 Electronic trap primer units shall be Precision Plumbing Products, models as follows:
  - .1 Model PT-4 for up to 4 trap system
  - .2 Model PT-6 for up to 6 trap system
  - .3 Model PT-8 for up to 8 trap system
  - .4 Model PT-10 for up to 10 trap system
  - .5 Model PT-12 for up to 12 trap system
- .3 Each unit shall be a packaged electronic trap priming manifold, to supply a minimum of 2oz. (59 mL) water per outlet port (based on 20-100 psi (137 kPa-689 kPa) system pressure), for 6 seconds every 24 hours as minimum.
- .4 The entire unit shall be factory assembled and comply pre-piped etc. for installation and shall include:
  - .1 Bronze body 3/4" (19mm) female NPT ball valve
  - .2 Electronic brass body 3/4" (19 mm) solenoid valve (120 V)
  - .3 Atmospheric type vacuum breaker
  - .4 Type L copper outlet manifold
  - .5 1/2" (13mm) O.D. brass compression outlet fittings with orificed opening (for water balancing to each trap) connected from outlet manifold.
- .5 Electrical components shall include:
  - .1 Single point 120V/1ph/60 Hz power connection
  - .2 Manual override switch
  - .3 2amp breaker
  - .4 24 hour field adjustable geared timer with adjustable dwell function (0-30 sec range)

.6 All components shall be factory mounted, assembled and tested, and supplied in a 16 gauge primed steel enclosure suitable for surface mounting (or recessed) mounting with hinged locking, door.
.7 All plumbing and electrical components shall be fully CSA approved.
.8 Unit shall be installed complete with 120” (3m) length of 14/2 with ground power cable with male 3-prong plug attached.
.9 Contractor shall `Cap Off' any unused water outlets.

2.5 CLEANOUTS [CO]

.1 Interior Unfinished Areas:
.1 Manufacturer: Watts Drainage Model CO-200-RX-4
.1 Epoxy coated cast iron floor cleanout with 5” (127mm) round adjustable gasketed heavy duty ductile iron top, removable gas tight gasketed brass cleanout plug and no hub connection.

.2 Interior Finished Floor Areas:
.1 Manufacturer: Watts Drainage Model CO-200-R
.1 Epoxy coated cast iron floor cleanout with 5” (127mm) round adjustable gasketed nickel bronze top, removable gas tight gasketed brass cleanout plug and no hub connection.
.2 Manufacturer: Watts Drainage Model CO-200-TS-1
.1 Epoxy coated cast iron body, 5" x 5" (127mm x 127mm) square adjustable gasketed nickel bronze top with tile recess, removable gas tight gasketed brass cleanout plug, no hub outlet.

.3 Interior Finished Wall Stack Cleanout:
.1 Manufacturer: Watts Drainage Model CO-460-RD
.2 Cast iron body with gasketed brass countersunk plug, stainless steel access cover, vandal proof stainless steel screw and no hub connections.

.4 Interior Stack Cleanout:
.1 Manufacturer: Watts Drainage Model CO-460
.2 Cast iron body with gasketed brass countersunk plug and no hub connections.

.5 Line Cleanout:
.1 Manufacturer: Watts Drainage Model CO-450-RD
.2 Epoxy coated cast iron wall cleanout with gasketed cover, no hub connection, stainless steel access cover, and vandal proof stainless steel screw.

.6 Caulking for cleanouts:
.1 VOC content not to exceed 250 g/L.

2.6 HYDRANTS

.1 Exterior Wall Hydrant – Single Temperature [WH-1]
.1 Manufacturer: Watts Drainage Model HY-725
.2 Concealed non-freeze key operated wall hydrant with nickel bronze box and door, chrome plated hydrant face, integral vacuum breaker, 3/4" (19mm) hose connection, all bronze head, seat casting and internal working parts, galvanized wall casing and hydrant key.

.2 Interior Wall Hydrant – Dual Temperature [WH-2]
- .1 Manufacturer: Watts Drainage Model HY-300-2-VB
- .2 Concealed key operated dual-temp wall hydrant with nickel bronze box and door, polished bronze hydrant face, 3/4" (19mm) hose connection, vacuum breaker, all bronze head, seat casting and internal working parts, galvanized wall casing, and hydrant key.

.3 Roof Hydrant [PH-1]
- .1 Manufacturer: Watts Drainage HY-900
- .2 Epoxy coated cast iron head with lift handle and lock option, galvanized casing, bronze internal working parts and valve housing, integral epoxy coated cast iron roof mounting plate with clamping collar, and 1/8" NPT drain port.

.4 Hose Bib [HB-1]
- .1 Manufacturer: Watts Drainage Series HB-1
- .2 Brass body construction with 1/2" (13mm) copper x 3/4" (19mm) hose thread connection, hose coupling, integral vacuum breaker, built-in backflow protection, and cast iron hand wheel.

2.7 BACKFLOW PREVENTERS [BFP], CHECK VALVES

.1 Double Check Valve Assembly (DCVA)
- .1 Manufacturer: Watts Drainage Series 007-QTM2
- .2 The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module seats and seat discs shall be replaceable. Service of all internal components shall be through a single bronze or stainless steel access cover secured with stainless steel bolts. The assembly shall also include two resilient seated isolation valves; four top mounted, resilient seated test cocks.
- .3 Compliance with CSA B64 and shall meet the requirements of ASSE Std. 1015 and AWWA Std. C510.

.2 Dual Check Valve serving equipment and appliances (serving coffee machines, water coolers, etc.)
- .1 Manufacturer: Watts LF7R
- .2 Lead Free* Double Check Valve Assemblies prevent the reverse flow of liquids in a plumbing system due to backpressure or back siphonage for non-health hazards. Compact design for easy installation in tight spaces. Single cover, top-entry design for convenient access for maintenance. The seats and seat discs are replaceable.

.3 Single Check Valve serving equipment and appliances as indicated on Drawings.
- .1 Manufacturer: Watts LF601
- .2 Lead Free* cast copper silicon alloy Maxi-Flo Check Valves used to prevent the effects of water hammer in the piping system. Lead Free* copper silicon alloy body, Viton disc, and integral copper silicon alloy seat. Low pressure drop, can be installed in a horizontal or vertical position.

.4 Vacuum Breakers
- .1 Manufacturer: Watts Drainage Model LF800M4QT

.2 Acetal bonnet with silicon rubber O-ring seal, lead free cast copper silicon alloy body, stainless steel springs, replaceable seat, silicone rubber seat disc, v-notch guided check assembly, tee handle quarter turn ball valve shut-offs, test cocks positioned for easy testing and winterization.

2.8 WATER HAMMER ARRESTORS

.1 Manufacturer: Watts Drainage Series LF15M2

.2 Pre-charged, copper body, polypropylene piston, EPDM o-ring seal, permanent sealed air chamber to absorb shock, NPT solid hex lead free brass adapter for easy installation, maintenance free-piston is the only moving part, air pre-load is 60psi (4.2bar). Designed to operate on all domestic and commercial lines up to 150psi (10.6bar) working pressure.

2.9 POTABLE HOT WATER AUTOMATIC FLOW LIMITING & BALANCING VALVES

.1 Brass, Solder end type, lead free, automatic flow limiting valve, valves designed to facilitate precise flow balancing of potable hot water. Operating pressure between 2 to 80 psi. Operating temperature range between 32°F to 212°F. Complete with changeable GPM flow cartridges, EPDM O-Ring and diaphragm, Polyphyenylsulfone orifice and certified to NSF/ANSI 61 & 372. Acceptable products are:
- .1 Caleffi AutoFlow 127 Series.
- .2 Hays Fluid Controls Model 2517LF.

.2 Solder end type, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with valved ports for connection to a differential pressure meter. Certified to NSF/ANSI 61 & 372. Acceptable products are:
- .1 Armstrong Fluid Technology Model CBV-S.
- .2 Tour and Anderson Model TBV-S or STAD/STAS.
- .3 RWV #9519AB.

2.10 PARTITION STOPS

.1 Dahl Brothers Canada Ltd., Fig. 2300 Series or approved equivalent bronze key operated partition stops with Teflon impregnated lifetime packing, slotted spindles, extension tubes, stainless steel access plates, and three identified keys.

2.11 MIXING VALVES [MV]

.1 Manufacturer: Leonard Valve SW-75-EVBD-RF
- .1 Manual water blender with 19mm (3/4") IPS hot water inlet and cold water inlet, two stop and check valves with colour coded heat resistant handles on inlets, (internal parts of stainless steel construction), stainless steel mixing chamber with 19mm (3/4") outlet with dial thermometer -5 to 115ºC (20 to 240ºF), vacuum breaker, chrome plated finish, hose connection, hose rack and a maximum operating pressure of 125 psi (8.6 bar).

2.12 THERMOSTATIC MIXING VALVES

.1 Master Mixing Valves TMV

.1 Manufacturer: Leonard Model TM-XXB-LF-D

.2 Rough bronze lead free thermostatic mixing valve assemblies, each complete with ball type shut-off valves, pressure regulating valve, angle check stops, and dial type thermometer all mounted in a surface wall mounted steel cabinet, with a plexi-glass window in door. Expand to pipe size show on Drawings before and after exiting the mixing valve. ASSE Lead Free Certified.

.1 TMV serving hot water tank in Office Area: Leonard TM-1520B-LF-DT-STSTL-REC; 32mm (1 ¼") diameter inlets and 38mm (1 ½") outlet. Maximum 35 kPa (5 psi) pressure drop @ 35-40 USgpm.

.2 Point of Use – Non-Emergency Device

.1 Manufacturer: Lawler Safety TMM-1070

.2 Bronze body construction, high temperature limit stop with shut off temperature of 118° (+/- 3°F), integral rubber duck-bill back-flow checks within inlets, temperature adjustment dial, thermostatic mechanical mixing valve with outlet temperature range within 95-115°F (35-46°C), ASSE 1070 approved, valve shall control temperature from a low of 1/2gpm, 1gpm at 10psi and 1.6gpm at 20psi drop across the valve, 3/8"Ø compression fit inlets and outlets, ASSE Lead Free Certified.

3 Execution

3.1 GENERAL

.1 Install all products in accordance with the plumbing code and with Manufacturer's instructions.

3.2 FLOOR DRAINS

.1 Provide floor drains where indicated on architectural and plumbing floor plans.

.2 Inspect locations where floor drains are shown to determine that floor is sloped appropriately. Report concerns to Consultant prior to installation of drains.

.3 Coordinate installation with general trades.

.4 Trap and vent all floor drains in accordance with Plumbing Code.

.5 Provide trap seal priming for each floor drain trap.

.6 Floor drains in floors with surface membranes shall be installed with a membrane clamp and anchoring flange.

.7 Floor drains, traps and drain pipes installed in slabs on grade shall be embedded in concrete and made water-tight to prevent water seepage.

3.3 TRAP SEAL PRIMERS

.1 Traps may be primed from the flush tube of a flush valve or from the waste of a drinking fountain.

.2 No more than three traps may be primed from one flush valve or one drinking fountain.

.3 Condensate drains from cooling units may not be used to prime traps.

.4 Electronic trap seal primers shall be provided where flush valves and/or drinking fountains are not available. Coordinate power requirements with Electrical Division.

.5 Group trap primers shall be provided where specifically shown and where agreed with the Consultant.

3.4 CLEANOUTS

.1 Cleanouts shall be the same size as the pipe up to 4" (100mm) and not less than 4" (100mm) for larger pipes.

.2 Provide cleanouts at the end of mains and branches, at changes in direction, in long straight runs and at the base of all soil stacks and rainwater leaders and where required by code.

.3 Extend cleanouts to finished floor or wall surface.

.4 Encase exterior cleanouts in concrete flush with grade.

.5 Install floor cleanouts at elevation to accommodate finished floor.

.6 Cleanouts in floors with surface membranes shall be installed with a membrane clamp and anchoring flange.

.7 Lubricate threaded cleanout plugs with mixture of graphite and linseed oil.

.8 Ensure clearance at cleanout for rodding of drainage system.

3.5 INTERCEPTORS

.1 Install interceptors so as to be accessible for cleaning and all other maintenance and repair which may be required.

.2 Make all piping connections. Vent in accordance with Ontario Building Code.

.3 Fill with appropriate media as required and turn over spare media to Owner.

3.6 HYDRANTS

.1 Locate wall hydrants where indicated.

.2 Coordinate installation with general trades.

.3 Provide a shut-off valve at every hydrant and hose bibb.

3.7 BACKFLOW PREVENTERS

.1 Backflow prevention includes backflow preventers, anti-siphon devices and vacuum breakers.

.2 Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur;

.1 housekeeping faucets,

.2 fire sprinkler systems,

.3 premise isolation,
.4 interior and exterior wall hydrants (hose bibbs).
.5 where require by codes, regulations and/or standards.

.3 Pipe relief or drain from backflow prevention device to nearest drain.

.4 Install a strainer upstream of each backflow preventer.

3.8 WATER HAMMER ARRESTORS

.1 Install water hammer arrestors complete with an accessible isolation valve on hot and cold water supply piping to;
.1 plumbing fixtures and fixture groups,
.2 Owner's equipment and appliances with flush valves, solenoid valves or other quick closing valves,
.3 downstream of each backflow preventer,
.4 wherever necessary to prevent water hammer.

3.9 INSTALLATION OF AUTOMATIC FLOW LIMITING & BALANCING VALVES

.1 Provide balancing valve(s) in potable hot water recirculation piping where shown.

.2 Locate each valve such that it is easily accessible.

3.10 INSTALLATION OF PARTITION STOPS

.1 Provide partition stops in potable water piping to each washroom plumbing fixture. Locate partition stops in piping near the floor level in inconspicuous locations. Confirm locations prior to roughing-in.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.2 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI):
  .1 ANSI B16.9, Factory-Made Wrought Buttwelding Fittings.
  .2 ANSI B36.19, American National Standard for Welded and Seamless wrought Steel Pipe.
  .3 ANSI B109.2, Diaphragm Type Gas Displacement Meters.

.2 American Society of Mechanical Engineers (ASME):
  .1 ASME B1.20.1, Pipe Threads, General Purpose.

.3 ASTM International Inc.:
  .1 ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  .2 ASTM A403, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
  .3 ASTM A420, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service.
  .4 ASTM B88, Standard Specification for Seamless Copper Water Tube.

.4 Canadian Standards Association (CSA International):
  .1 CSA B137.4, Polyethylene (PE) Piping Systems Fittings for Gas Services.
  .2 CSA B149.1, Natural Gas and Propane Installation Code.
  .3 ANSI LC4/CSA 6.32, Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems.

1.3 SUBMITTALS

.1 Shop Drawings: Submit shop drawings for all products specified in Part 2 of this Section except for the pipe and fittings.

.2 Test Data: Submit piping system leakage test sheets as specified in Section 20 05 00.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00.

.2 Deliver materials to site in its original factory packaging, labelled with the Manufacturer's name and address.

.3 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 PIPING, FITTINGS AND JOINTS

.1 Uncoated Black Steel - Screwed Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with malleable cast iron screwed fittings in accordance with ASME B1.20.1, and screwed joints.

.2 Uncoated Black Steel - Welded Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, mill or site beveled, complete with factory made forged steel butt welding fittings and welded joints.

2.2 SHUTOFF VALVES

.1 Ball Type: CSA certified, minimum 3100 kPa (450 psi) WOG rated, quarter turn, full port non-lubricated brass ball valves, each complete with a Teflon PTFE seat, chrome plated solid ball, removable lever handle, and screwed ends. Acceptable products are:

.1 Neo Valves Ltd. #525
.2 Kitz Corp. Code 58
.3 Toyo Valve Co. Fig. 5044A
.4 M.A. Stewart & Sons Ltd. MAS B-3
.5 Nibco Inc. #T-FP-600

.2 Plug Type: CSA certified, plain face flanged, Class 125, 1380 kPa (200 psi) rated, quarter turn, cast iron lubricated plug valves, each wrench operated and complete with cylindrical plug with lubricant grooves, lubricant screw, and lubricant receptacle. Acceptable products are:

.1 Neo Valves Ltd. #1AS40114
.2 Newman Hattersley Ltd. #171M
.3 KITZ Corporation 150 SCTAM-FS (flanged, 150 class, ball valve, 13mm to 250mm (½" to 10")) CGA/CSA 3.16

2.3 PRESSURE REDUCING REGULATORS

.1 Provide Fisher, Itron, or Maxitrol pressure reducing regulators as indicated on the Contract Drawings. Also provide pressure reducing regulators to suit the building load complete with relief.

2.4 FLEXIBLE APPLIANCE CONNECTORS

.1 Stainless Steel Flexible Hose: CSA certified, annealed 304 stainless steel tubing coated in antimicrobial PVC or equivalent polymer, carbon steel flare nut and adapter coated with zinc trivalent chromate plating, multi-strain stainless steel protective braiding to be included on connectors for movable appliances.

.1 Connectors for moveable equipment to comply with ANSI Z21.69/CSA 6.16
.2 Connectors for stationary equipment to comply with ANSI Z21.24/CSA6.10
.3 Connectors for outdoor equipment to comply with ANSIZ21.75/CSA 6.27

3 Execution

3.1 NATURAL GAS SERVICE

.1 Make all required arrangement with the natural gas supply utility on behalf of the Owner for installation of natural gas service piping with gas pressure regulator and meter assembly where shown on the Drawings.

3.2 NATURAL GAS PIPING INSTALLATION REQUIREMENTS

.1 Provide all required natural gas distribution piping and connect gas fired or operated equipment, and provide all required vent piping to the atmosphere, including vent piping from pressure regulators. Perform all piping work in accordance with the requirements of CSA International B149.1, Natural Gas and Propane Installation Code.

.2 Piping shall be as follows:

.1 For underground piping, coated Schedule 40 black steel, soft copper, or polyethylene.

.2 For above ground piping, uncoated Schedule 40 black steel, hard temper or soft copper, or if permitted, flexible stainless steel.

.3 Install flexible stainless steel pipe in strict accordance with the pipe Manufacturer's printed instructions.

.4 Slope gas piping in the direction of flow to low points.

.5 Provide full pipe diameter 150mm (6") long drip pockets at the bottom of all vertical risers, at all piping low points, and wherever else shown and/or required by the Contract Documents.

.6 Identify all natural gas piping with two coats of safety yellow enamel applied over primer, and SMS Ltd. coil type vinyl identification makers with arrows.

.7 Where movable equipment is being installed or a rigid connection cannot be facilitated a flexible appliance connector shall be used.

3.3 INSTALLATION OF SHUTOFF VALVES

.1 Provide CSA/TSSA approved ball type or lubricated plug type shut-off valves to isolate equipment, and wherever else shown on the Drawings.

.2 Ensure that valves are located for easy accessibility and maintenance.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00
.3 Section 22 11 19

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International):
  .1 CAN/CSA-B45 Series, Plumbing Fixtures.
  .2 CAN/CSA-B125.3, Plumbing Fittings.
  .3 CAN/CSA-B651, Accessible Design for the Built Environment.

1.3 ACTIONS AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00.

.2 Product Data:
  .1 Provide Manufacturer's printed product literature and datasheets for fixtures and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Closeout Submittals:
  .1 Provide maintenance data in accordance with Section 01 78 00.

.4 Include:
  .1 Description of fixture and trim, giving Manufacturer's name, type, model, year, capacity.
  .2 Details of operation, servicing, maintenance.
  .3 List of recommended spare parts.

.5 Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 DELIVERY, STORAGE AND DISPOSAL

.1 Waste Management and Disposal:
  .1 Separate waste materials for reuse and recycling.
  .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material, in appropriate on-site bins.
  .3 Fold up metal and plastic banding, flatten and place in designated area for recycling.

2 Products

2.1 PLUMBING FIXTURE AND FITTING SCHEDULE

.1 For plumbing fixture and fitting Manufacturers, catalogue numbers, and specific requirements, refer to the Drawing schedule of plumbing fixtures and fittings.

.2 Unless otherwise specified in the Contract Documents, requirements specified below apply to the plumbing fixtures and fittings scheduled on the Drawings.

2.2 GENERAL: PLUMBING FIXTURES AND FITTINGS

.1 Fixtures and fittings, where applicable, shall be in accordance with the requirements of CSA B45 Series, Plumbing Fixtures.

.2 All fixtures and fittings for use by the handicapped are to be in accordance with Ontario Building Code requirements.

.3 Unless otherwise specified in the Contract Documents, all vitreous china and porcelain enamelled fixtures shall be white.

.4 Unless otherwise specified in the Contract Documents, all fittings exposed to view shall be chrome plated and polished.

.5 All fittings located in areas other than private washrooms shall be vandal-proof.

.6 All fixtures carriers shall be suitable in all respects for the fixture they support and the construction in which they are located.

2.3 WATER CLOSETS

.1 Designation **WC-1**

.1 General Use, Wall Hung, Flush Valve Water Closet.

.2 Fixture: American Standard Afwall Millennium FloWise Elongated no. 3351101.020 HET Toilet, vitreous china with EverClean antimicrobial surface which inhibits the growth of stain and odor causing bacteria mold and mildew, elongated bowl, white finish, wall hung, siphon jet flush action, operates in the range of 4.2 L to 6.0 L (1.1 USG to 1.6USG) per flush, condensate channel, 305mm x 254mm (12" x 10") water surface, elongated bowl, 54mm (2-1/8") fully glazed internal trapway, 38mm (1-1/2") diameter top spud.

.3 Seat: Centoco no. 500STSCCSS.001 toilet seat, heavy duty, for elongated bowl, open front, solid plastic, less cover, stainless steel self-sustaining check hinges, metal flat washers stainless steel posts and nuts.

.4 Valve: Sloan G2 Optima Plus no. 8111-1.28-CP, exposed flushometer for top spud toilet, polished chrome finish, 4.8 L (1.28 USG) factory set flow, quiet action 'PERMEX' diaphragm type with dual filter by-pass, infrared sensor with multiple-focused lobular sensing fields for high and low target sensing, circuitry, courtesy flush electronic override button, vandal proof smooth design stop cap on back-check angle stop (screwdriver operated), flush tube for 292mm (11-1/2") rough-in, high pressure vacuum breaker, patented 'Isolated Operator' for superior performance under a heavy duty metal stylish cover with plastic optical face, four 'AA' batteries (included) serviceable without shutting off water with 'Low Battery' flashing LED.

.5 Carrier: Watts no. ISCA-101-M11 single horizontal adjustable toilet carrier, mounted on concrete floor, all epoxy coated cast iron fitting, adjustable ABS slide nipple with integral test cap and neoprene bowl gasket, wasted plated hardware, chrome cap nuts, tiling frame, 102mm (4") no hub waste, 51mm (2") no hub vent, 158.8kg (350lbs) static load. 305mm (12") finished metal stud wall to back of pipe space.

2.4 LAVATORIES

.1 Designation **LAV-1**

.1 Barrier Free Counter Mounted Lavatory

.2 Fixture: American Standard Ovalyn Universal Access no. 9482.000.020 basin, no faucet hole drilling, 489mm x 400mm x 140mm (19-1/4" x 15-3/4" x 5-1/2") high, oval, vitreous china, white finish, undercounter, rear overflow, no. 047194-007A undermount clips. Provide basin rim sealant.

.3 Faucet: American Standard Selectronic Integrated no. 7055.105.002 faucet, center hole only, vandal resistant brass construction, 0.5 GPM (1.9 LPM) pressure compensating vandal-resistant multi-laminar spray, polished chrome finish, 140mm (5-1/2") projection reach, multifunction sensor, PWRX 10-year battery system.

.4 Thermostatic Mixing Valve: Lawler no. TMM-1070-REC, below deck mechanical water mixing valve, bronze body, temperature adjusting dial, 10mm (3/8") inlets and outlet compression fittings, high temperature thermostatic limit stop, shut-off with automatic reset when temperature exceeds 120ºF (48.8ºC), integral checks, offer temperature range from full cold through 46°C (114.8°F), housed in 356mm x 356mm x 152mm (14" x 14" x 6") recessed box. Provide tee, adaptors and flexible copper tubing to suit installation.

.5 Waste Fitting: McGuire no. 155A open grid drain, cast brass one piece top, 17ga. (1.5mm) tubular 32mm (1-1/4") tailpiece.

.6 Supplies: McGuire no. LFH170BV faucet supplies, chrome plated finish polished brass, commercial duty 1/4 turn ball valve angle stops, 13mm (1/2") I.D., inlet x 127mm (5") horizontal extension tubes, convertible 1/4 turn/loose key handles, escutcheon and flexible copper risers.

.7 Trap: McGuire no. 8872C P-Trap, heavy cast brass adjustable body, with slip nut, 32mm (1-1/4") size, shallow wall flange and seamless tubular wall bend.

.2 Designation **LAV-2**

.1 Barrier free Wall Hung Lavatory

.2 Fixture: American Standard Murro no. 0955.001EC/0059.020EC basin, center hole only, 540mm x 520mm x 165mm (21-1/4" x 20-1/2" x 6-1/2") high, vitreous china, white finish, for carrier with concealed arms, rear overflow, recessed self-draining faucet ledge, semi-pedestal P-trap cover.

.3 Faucet: American Standard Selectronic Integrated no. 7055.105.002 faucet, center hole only, vandal resistant brass construction, 0.5 GPM (1.9 LPM) pressure compensating vandal-resistant multi-laminar spray, polished chrome finish, 140mm (5-1/2") projection reach, multifunction sensor, PWRX 10-year battery system.

.4 Thermostatic Mixing Valve: Lawler no. TMM-1070, below deck mechanical water mixing valve, bronze body, temperature adjusting dial, 10mm (3/8") inlets and outlet compression fittings, high temperature thermostatic limit stop, shut-off with automatic reset when temperature exceeds 120ºF (48.8ºC), integral checks, offer temperature range from full cold through 46°C (114.8°F). Provide tee, adaptors and flexible copper tubing to suit installation.

.5 Waste Fitting: McGuire no. 155A open grid drain, cast brass one piece top, 17ga. (1.5mm) tubular 32mm (1-1/4") tailpiece.

.6 Supplies: McGuire no. LFH170BVRB faucet supplies, chrome plated finish polished brass, commercial duty 1/4 turn ball valve angle stops, 13mm (1/2") I.D., inlet x 127mm (5") horizontal extension tubes, convertible 1/4 turn/loose key handles, escutcheon and stainless steel braided flexible risers.

.7 Trap: McGuire no. 8872C P-Trap, heavy cast brass adjustable body, with slip nut, 32mm (1-1/4") size, shallow wall flange and seamless tubular wall bend.

.8 Carrier: Watts no. WCA-411-CA-481 basin carrier, concealed arms, wall flanges to attach to backing plate secured in wall with locking device and levelling screws, heavy gauge steel uprights with integral welded feet. For one unit: 102mm (4") for two to six units in a row: 152mm (6") finished metal stud wall to back of pipe space.

2.5 SINKS

.1 Designation **S-1**

.1 Single Compartment Stainless Steel Sink

.2 Fixture: Franke Commercial no. ALBS4006P-1/1 single bowl countertop mount sink, 1 hole, 562mm (22-1/8") wide x 478mm (18-13/16") long x 152mm (6") deep, counter mounted, back ledge, grade 18-10 18ga. (1.2mm) type 304 stainless steel, self-rimming, satin finish rim and bowls, mounting kit provided, fully undercoated to reduce condensation and resonance, factory applied rim seal, 3-1/2" (89mm) crumb cup waste assembly with 1-1/2" (38mm) tailpiece.

.3 Faucet: American Colony Pro no. 7074.100 kitchen faucet with pull out spray, single handle faucet, swivel body, pull-out sprayer with 2 spray function, polished chrome finish, washerless ceramic disc cartridge, 220mm (8.7") projection reach, 5.7 LPM (1.5 GPM).

.4 Thermostatic Mixing Valve: Lawler no. TMM-1070, below deck mechanical water mixing valve, bronze body, temperature adjusting dial, 10mm (3/8") inlets and outlet compression fittings, high temperature thermostatic limit stop, shut-off with automatic reset when temperature exceeds 120ºF (48.8ºC), integral checks, offer temperature range from full cold through 46°C (114.8°F). Provide tee, adaptors and flexible copper tubing to suit installation.

.5 Supplies: McGuire no. LFBV170 faucet supplies, chrome plated finish polished brass, commercial duty 1/4 turn ball valve angle stops, 13mm (1/2") I.D., inlet x 127mm (5") horizontal extension tubes, convertible 1/4 turn/loose key handles, escutcheon and flexible copper risers.

.6 Trap: McGuire no. 8912CB P-Trap, heavy cast brass adjustable body, with slip nut, 38mm (1-1/2") size, box flange and seamless tubular wall bend.

.2 Designation **KS-1**

.1 Two Compartment Built-in Sink

.2 Fixture: Built-in.

.3 Faucet: American Colony Pro no. 7074.100 kitchen faucet with pull out spray, single handle faucet, swivel body, pull-out sprayer with 2 spray function, polished chrome finish, washerless ceramic disc cartridge, 220mm (8.7") projection reach, 5.7 LPM (1.5 GPM).

.4 Thermostatic Mixing Valve: Lawler no. TMM-1070, below deck mechanical water mixing valve, bronze body, temperature adjusting dial, 10mm (3/8") inlets and outlet compression fittings, high temperature thermostatic limit stop, shut-off with automatic reset when temperature exceeds 120ºF (48.8ºC), integral checks, offer temperature range from full cold through 46°C (114.8°F). Provide tee, adaptors and flexible copper tubing to suit installation.

.5 Supplies: McGuire no. LFBV170 faucet supplies, chrome plated finish polished brass, commercial duty 1/4 turn ball valve angle stops, 13mm (1/2") I.D., inlet x 127mm (5") horizontal extension tubes, convertible 1/4 turn/loose key handles, escutcheon and flexible copper risers.

.6 Trap: McGuire no. 8912CB P-Trap, heavy cast brass adjustable body, with slip nut, 38mm (1-1/2") size, box flange and seamless tubular wall bend.

.3 Designation **KS-2**

.1 Three Compartment Built-in Sink

.2 Fixture: Built-in

.3 Faucet: Chicago Faucets no 523-613-369ABCP, Wall-hung, Manual, Two handles, Pre-rinse fitting, Polished chrome finish, 184 - 222mm (7-1/4" - 8-3/4") adjustable center set, Lead free compliant, ECAST® brass construction, Less supply, 10mm (3/8") offset inlet supply arms, Ceramic cartridge, 3.8 LPM (1.0 GPM) maximum flowrate @60 PSI, Spray outlet, L-type spout, Pull down, 292mm (11-1/2") spout reach, 1045mm (41-1/8") high, 584mm (23") stainless steel hose, Vandal-resistant 60mm (2-3/8") lever handle with indexed buttons, Less drain, Less side spray, 13mm (1/2") NPSM supply inlet.

.4 Thermostatic Mixing Valve: Lawler no. TMM-1070, below deck mechanical water mixing valve, bronze body, temperature adjusting dial, 10mm (3/8") inlets and outlet compression fittings, high temperature thermostatic limit stop, shut-off with automatic reset when temperature exceeds 120ºF (48.8ºC), integral checks, offer temperature range from full cold through 46°C (114.8°F). Provide tee, adaptors and flexible copper tubing to suit installation.

.5 Supplies: McGuire no. LFBV170 faucet supplies, chrome plated finish polished brass, commercial duty 1/4 turn ball valve angle stops, 13mm (1/2") I.D., inlet x 127mm (5") horizontal extension tubes, convertible 1/4 turn/loose key handles, escutcheon and flexible copper risers.

.6 Trap: McGuire no. 8912CB P-Trap, heavy cast brass adjustable body, with slip nut, 38mm (1-1/2") size, box flange and seamless tubular wall bend.

.4 Designation **JS-1**

.1 Floor Mounted Service Sink

.2 Fixture: FIAT no. MSB2424100 square service / mop sink, 610mm (24") wide x 610mm (24") long x 254mm (10") deep, floor mounted, molded stone, white, plain curbs, stainless steel drain with strainer, 3" (76mm) outlet.

.3 Faucet: FIAT no. 830-AA wall mounted two handles faucet, chrome plated finish, wall mount 8" (203mm) center set, cast brass body, 22.7LPM (6.0GPM) unrestricted hose end outlet, 152mm (6") projection

spout with atmospheric vacuum breaker and bucket hook, 237mm (9-5/16") from wall to outlet reach, cross handle, top brace.

.4 Bumper Guard: FIAT no. E88AA24000 bumper guard 610mm (24") stainless steel.

.5 Hose & Wall Hook: FIAT no. 832AA000 hose and wall hook 30" (762mm) long flexible heavy duty 5/8" rubber hose, cloth reinforced with 3/4" chrome coupling. Bracket is 5"(127mm) long by 3" (76.2mm) stainless steel rubber grip.

.6 Hanger: FIAT no. 889CC000 mop hanger, 22ga. (0.8mm) type 304 stainless steel.

.5 Designation **LS-1**

.1 Floor Mounted Laundry Sink

.2 Fixture: FIAT no. SF1-A3000100F Floor mounted, Single compartment sink, 102mm (4") center set, Laundry sink, with overall dimension 508mm (20") long, 606mm (23-7/8") wide, 856mm (33-11/16") high, constructed from Plastic polymer, Bowl dimensions are 495mm (19-1/2") long, 498mm (19-5/8") wide, 365mm (14-3/8") deep, White baked enamel steel angle legs that fit into the molded retainers located in each of four corners of the underside of the laundry tub, legs are supplied with leveling, includes two soap dish locations, Integrally molded drain, plastic stopper and tailpiece nut with washer are supplied with all models, Polypropylene faucet block, 130mm (5-1/8") x 38mm (1-1/2") for installing clamp-on or integral clamp faucets to deck to accept over-head water supplies (A3), Overflow tube (A15).

.3 Faucet: Chicago Faucets 526-317ABCP Faucet - Counter mounted, Manual, Two handles, Sink faucet, Polished chrome finish, 102mm (4") center set, Lead Free ANSI/NSF 61 and ANSI/NSF 372 compliant, ECAST® brass construction, Less supply, 1/4 turn compression cartridge, No flow restrictor, Quixtop outlet with single-screen design, Double-bend spout, 159mm (6-1/4") spout reach, 197mm (7-3/4") high, Vandal-resistant wrist blade handles, Less drain, 13mm (1/2") NPSM supply inlet for 10mm (3/8") or 13mm (1/2") flexible riser.

.4 Thermostatic Mixing Valve: Lawler no. TMM-1070, below deck mechanical water mixing valve, bronze body, temperature adjusting dial, 10mm (3/8") inlets and outlet compression fittings, high temperature thermostatic limit stop, shut-off with automatic reset when temperature exceeds 120ºF (48.8ºC), integral checks, offer temperature range from full cold through 46°C (114.8°F). Provide tee, adaptors and flexible copper tubing to suit installation.

.5 Supplies: McGuire no. LFCK2165CCLK Lead free, Nominal to compression, Integral check supply kit, Chrome-plated finish, 1/2" Nominal x 3/8" O.D, 305mm (12") chrome-plated risers, Loose key, Faucet, Shallow wall flange

.6 Trap: McGuire no. 8912CB P-Trap, heavy cast brass adjustable body, with slip nut, 38mm (1-1/2") size, box flange and seamless tubular wall bend.

2.6 EMERGENCY FIXTURES

.1 Designation **EW-1**

.1 Fixture: Guardian no. G1750P-T-YEL, wall mounted, eye/face wash, 298mm (11-3/4") diameter bowl, yellow ABS plastic bowl, two FS-Plus spray heads with flip-top dust cover and filter, powder coated cast aluminum flag handle activation, 1/2" (13mm) IPS chrome plated brass stay-open ball valve with Teflon seal, heavy duty cast aluminum wall bracket with corrosion resistant powder coated finish, chrome plated brass tailpiece and trap with 1-1/2" (38mm) IPS waste connection, 1-1/4" (32mm) NPT female outlet. Unit is third party certified by IAPMO to meet ANSI Z358.1, the Uniform Plumbing Code cUPC and the National Plumbing Code of Canada. Eyewash/Facewash fixture should be installed 4 to 10 feet from the mixing valve.

.2 Thermostatic Mixing Valve: Lawler no. 911E/F, emergency thermostatic mixing valve for Eyewash or Eye/Face Wash, lead-free brass and stainless steel design, vandal resistant temperature adjustment, stainless steel sliding piston control device allow cold flow through both the fixed and variable bypass, 13mm (1/2") N.P.T., outlet, positive hot water shut-off, liquid-filled thermostatic motor control mechanism, 29°C (84.2°F) factory set temperature, standard 69.8°F (21°C) - 89.6°F (32°C) temperature range, 26LPM (6.9GPM) flow capacity at 30psi (207kPa) pressure drop across the valve, 7.57LPM (2.0GPM) min. Flow rate, 18LPM (4.8GPM) bypass flowrate at 30psig. Provide shut-offs at emergency mixing valve.

2.7 ACCEPTABLE MANUFACTURERS

.1 Vitreous china and enameled cast iron or steel fixtures: Zurn, Sloan, American Standard, Toto, and Kohler.

.2 Stainless steel sinks: Franke, AERO, Novanni Stainless Inc., Kindred Industries "Aristaline”.

.3 Precast terrazzo fixtures: Acorn, Fiat Products Ltd. and Stern-Williams.

.4 Water closet seats: Zurn, Bemis, Centoco, Olsonite and Beneke.

.5 Flush valves: Zurn, Sloan, American Standard, Toto, and Delta Commercial.

.6 Fixture carriers: Zurn, Mifab, Jay R. Smith and Watts Industries .

.7 Faucets: unless otherwise specified, Zurn, Delta Commercial, American Standard, Kohler and Chicago Faucet.

.8 Fixture trim: unless otherwise specified, McGuire, Zurn, American Standard , Kohler.

.9 Shower valves: American Standard, Moen, Kohler, Delta Commercial, Grohe.

3 Execution

3.1 INSTALLATION OF PLUMBING FIXTURES AND FITTINGS

.1 Provide all required plumbing fixtures and fittings.

.2 Provide isolation valves (ball valves) for all fixtures.

.3 Connect plumbing fixtures and fittings with piping sized in accordance with the Drawing schedule.

.4 Confirm the exact location of all plumbing fixtures and trim prior to roughing-in.

.5 When installation is complete, check and test the operation of each fixture and fitting. Adjust or repair as required.

.6 Counter Mounted Fixtures and Trim: Supply templates for all counter mounted fixtures and trim and hand to the trade who will but the counter. Ensure openings in the counter are properly located.

.7 Electronic Lavatory Faucets: Locate control panels for electronic faucets under the lavatories and recessed into the wall. It is the intent to locate the transformer(s) (power converter(s)) in the wall cavity or concealed under counters. Provide access doors accordingly for servicing of transformer(s). Coordinate locations with the work of Division 26 that will provide 120 vac line supply to the transformers(s). Provide low voltage wiring from the transformer(s) to each terminal point in control panel(s) under lavatories. All water and electronic supply from control panel to faucet shall be through the flexible conduit supplied with the control panel. Connect hot and cold water piping to the mixing valve in each box, and tempered water piping from each mixing valve to the faucet. Set mixing valve maximum temperature limit stops to 43ºC. (109ºF) after potable water systems (hot and cold) are complete. Ensure that each programmable controller is properly programmed, and that water off after deactivation is set for three seconds. **Note:** All electrical line supply and low voltage wiring, including any wall receptacles as well as low voltage wiring to boxes shall be concealed.

.8 Thermostatic Mixing Valves: The device shall be designed to be installed at a single outlet. It may be used to supply individual outlets when there is sufficient supply pressure. Ball valves shall be installed on the hot and cold inlet supplies. Temperature shall be field set. Maximum pressure differential shall be 103 kPa (15 psi) between hot and cold inlets. Integral check valves and strainer screen shall be installed on hot and cold supply.

3.2 ADJUSTING

.1 Adjust the water flow rate to design flow rates.

.2 Adjust the pressure to fixtures to ensure no splashing at maximum pressures.

.3 Checks:

.1 Aerators: Verify operation, cleanliness.

.2 Vacuum breakers, backflow preventers: Verify operation under all conditions.

.3 Thermostatic controls: Verify temperature settings, operation of control, limit and safety controls.

3.3 CLEANING AND PROTECTION

.1 After completing the installation of fixtures, inspect and repair damaged finishes.

.2 Clean fixtures, faucets, valves and other fittings with the manufacturers' recommended cleaning methods and materials.

.3 Provide protective covering for installed fixtures and fittings.

.4 Do not allow the use of fixtures for temporary facilities unless approved in writing by the Owner.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.2 REFERENCE STANDARDS

.1 ASHRAE HANDBOOK, HVAC SYSTEMS & EQUIPMENT, Duct Construction Recommendations.

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
- .1 HVAC Duct Construction Standards - Metal and Flexible
- .2 HVAC Duct Systems Design
- .3 Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
- .4 Accepted Industry Practice for Industrial Duct Design
- .5 HVAC Systems - Testing, Adjusting and Balancing
- .6 Round Industrial Duct Construction Standards
- .7 Rectangular Industrial Duct Construction Standards
- .8 HVAC Air Duct Leakage Test Manual.
- .9 Guide for Steel Stack Construction

.3 National Fire Protection Association (NFPA):
- .1 80 Standard for Fire Doors and Windows
- .2 90A Standard for Installation of AC and Ventilation Systems
- .3 90B Standard for Installation of Warm Air Heating and AC Systems
- .4 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .5 255 Building Materials, Test of Burning Characteristics (same as ASTM E84)

.4 American Society for Testing and Materials (ASTM):
- .1 A90/A90M - Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- .2 A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .3 A480/A480M - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- .4 A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .5 A1011/A1011M - Standard Specification for Steel, Sheet, and Strip Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy with Improved Formability.
- .6 B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .7 A240 Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels
- .8 A480 Standard Specification for General Requirements for Flat Rolled Stainless Heat-Resisting Steel Plate, Sheet and Strip
- .9 A653 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated by the Hot Dip Process .

.10 E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
.11 E477 Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Material and Prefabricated Silencers
.12 E814 Standard Test Method for Fire Tests of Through Penetration Fire Stops

.5 Underwriter's Laboratories (UL)
.1 181 Factory Made Air Ducts and Air Connectors
.2 555 Standard for Safety Fire Dampers
.3 555S Leakage Rated Dampers for Use in Smoke Control Systems
.4 723 Test for Surface Burning Characteristics of Burning Materials (ASTM E84)

1.3 PERFORMANCE REQUIREMENTS

.1 No variation of duct configuration or sizes permitted except by written permission.

.2 Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.

.3 Sizes indicated on Drawings are clear inside dimensions and do not include for duct linings.

1.4 SUBMITTALS

.1 Shop drawings and product Data: data for duct materials.

.2 Submit changes or alterations in ductwork layout, with supporting calculations showing that the modified design will not increase total pressure, before work commences. Submittals for proposed changes shall be stamped for acceptance prior to commencement of work.

.3 Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

.4 Safety Data Sheets (SDS) for sealants, adhesives and coatings.

.5 Manufacturer's Installation Instructions: Indicate special procedures for glass fibre ducts.

.6 Submit two samples of typical shop fabricated duct fittings.

1.5 PROJECT RECORD DOCUMENTS

.1 Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

.1 Perform Work to SMACNA - HVAC Duct Construction Standards - Metal and Flexible. .

.2 Perform Duct Leakage Testing to SMACNA "HVAC Air Duct Leakage Testing Manual"

.3 Maintain one copy of document on-site.

.4 Asbestos Free: Insulating and sealing materials must be certified to be free of asbestos.

.5 Brazing: Certify brazing procedures, brazers, and operators in accordance with AWS B2.2 Brazing Procedures and Performance Qualifications

1.7 REGULATORY REQUIREMENTS

.1 Ontario Building Code (OBC)
.2 Ontario Fire Code (OFC)
.3 Construct ductwork to NFPA 90A standards.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Do not install duct sealants when temperatures are less than those recommended by sealant Manufacturers.

.2 Maintain temperatures during and after installation of duct sealants.

2 Products

2.1 MATERIALS

.1 Table of materials:

Application	Materials
Rigid HVAC ducts, casings and fittings	ASTM A653 galvanized steel sheet, lock form quality, G90 zinc coating (0.90oz/ft²) to ASTM A90. Sheets free of pits, blisters, slivers, and ungalvanized spots.
Aluminum Ducts, dryer vents	ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.

.2 Hanger Rod: continuously threaded, ASTM A36 galvanized steel in general, stainless steel for stainless steel ducts.

.3 Sealant: Non-hardening, water resistant, fire resistive, low VOC (VOC content not to exceed 250g/L), compatible with mating materials; liquid used alone or with tape, or heavy mastic.

.4 Supports: Angle iron, channels, rods and related supporting materials shall be galvanized or red oxide coated.

.5 Fasteners: Use galvanized rivets, screws and bolts throughout, except on stainless steel ductwork, use SS fasteners.

.6 Reinforcements: Provide galvanized steel or stainless steel reinforcement shapes and plates to match ductwork.

.7 Tie Rods: Use galvanized steel, 1/4" minimum diameter fasteners for ductwork 36” (900mm) or less in length; use 3/8” minimum diameter for lengths longer than 36” (900mm).

.8 Thickness, fabrication and reinforcement to SMACNA.

2.2 DUCT CONSTRUCTION

.1 Duct construction schedule:

Duct Application	Duct Pressure	Pressure Class (in. wg.)	Seal Class	Leakage Class
Rectangular HVAC supply from AHU to terminal unit or reheat coil	Positive	4	A	6
Round HVAC supply from AHU to terminal unit or reheat coil	Positive	4	A	3
Rectangular HVAC single zone supply from unit to air outlet	Positive	2	A	6
Round HVAC single zone supply from unit to air outlet	Positive	2	A	3
Rectangular HVAC return from air inlet to AHU	Negative	2	A	6
Round HVAC return from air inlet to AHU	Negative	2	A	3
Rectangular sanitary exhaust ductwork	Negative	2	A	6
Round sanitary exhaust ductwork	Negative	2	A	3
Rectangular general HVAC exhaust	Negative	2	A	6
Round general HVAC exhaust	Negative	2	A	3
Exhaust fan discharge ductwork	Positive	2	A	0

.2 Note:

.1 Pressure class shall be the lower of the exhaust fan shut-off pressure or value shown.

2.3 DUCT SEALING

.1 Duct sealing schedule:

Seal Class	Sealing Requirements
A	All transverse joints, longitudinal seams and duct wall penetrations.
B	All transverse joints and longitudinal seams.
C	All transverse joints.

2.4 DUCT LEAKAGE

.1 Leakage Class is defined as

$CL = F / (P)^{0.65}$

where: CL = Leakage Class

F = Leakage Factor (cfm/100ft² of duct surface)

P = Static pressure in the duct (in.wg.)

.2 Table

Leakage Factor (F) CFM/100sq.ft. of duct surface					
Leakage Class	Pressure Class (in.wg.) Positive or Negative				
C_L	1	2	4	6	10
12	12	19	30	38	54
6	6	9	15	19	27
3	3	5	7	10	13
0	0	0	0	0	0

2.5 DUCTWORK FABRICATION

.1 All Ductwork shall be constructed to withstand 1-1/2 times fan pressure at shut-off and 2" wc (500 Pa) minimum.

.2 Fabricate and support to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated in accordance with recommendations of ASHRAE and SMACNA.

.3 Joints and reinforcements:
- .1 to SMACNA and ASHRAE
- .2 may be made with the Ductmate System or Nexus System. System components shall be made of standard catalogue manufacture as supplied by Ductmate Industries, Inc. Or Nexus Inc.

.4 Construct Tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centreline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fibre insulation.

.5 Increase duct sizes gradually, not exceeding 15° divergence wherever possible; maximum 30° divergence upstream of equipment and 45° convergence downstream.

.6 Provide standard 45° lateral wye takeoffs. Alternative 90° conical tee connections may be used only where specifically indicated.

2.6 ROUND SPIRAL LOCK SEAM DUCTWORK

.1 Spiral ducts and elbows shall not be used for watertight exhaust systems.

.2 Ducts and fittings shall be manufactured from minimum G90 galvanized steel meeting ASTM A527/A527M-85.

.3 Ductwork shall be "Uni-Seal" single wall, round spiral lock-seam type duct with wall thicknesses listed below.

.4 Fittings shall be "Uni-Form" single wall, round fittings suitable for use with "Uni-Seal" ductwork in wall thicknesses as follows:

Diameter in. (mm)	Duct Metal Thickness in. (Ga.) (mm)	Fitting Metal Thickness in. (Ga.) (mm)
3-14 (75-350)	0.022 (26) (0.56)	0.028 (24) (0.70)
15-26 (375-650)	0.028 (24) (0.70)	0.034 (22) (0.86)
27-36 (675-900)	0.034 (22) (0.86)	0.040 (20) (1.00)
37-50 (925-1250)	0.040 (20) (1.00)	0.052 (18) (1.32)
52-60 (1300-1500)	0.052 (18) (1.32)	0.064 (16) (1.62)

.5 Acceptable Manufacturer: "Uni-Seal" spiral lock-seam duct and "Uni-Form" fittings as manufactured by United Sheet Metal. Other Manufacturers subject to shop drawing review.

2.7 FLEXIBLE DUCTWORK

.1 Flexible ducts shall be factory fabricated to CAN/ULC S110, factory fabricated assembly with a laminated inner liner of aluminum foil, fibreglass and polyester, a galvanized steel helix coil formed to the inner liner, a fibreglass insulation blanket, and a polyethylene outer jacket. Flexible duct shall have a flame-resistant rating of 25 or less and a smoke developed rating of 50 or less.

Pressure Rating	Low and Medium in. wg. (kPa)
Maximum positive pressure	6.0 (3.0)
Maximum negative pressure	4.0 (2.0)
Maximum velocity	4000fpm (20m/s)
Permeance	0.1perm
Operating temperature	-20F to 250F (-29C to121C)
Maximum thermal conductance	0.23BTU/Hr-F
Listed and labelled	Class 0 / Class 1
Flexmaster Type	5

.2 Accessories: conical spin-in collars with butterfly volume dampers for connections to ductwork, round rigid galvanized steel fittings fabricated to SMACNA Standards and ASHRAE recommendations, bridge and gear clamps. .

.3 Alternate manufacturers are subject to shop drawing review.

2.8 FIRE RATED DUCT WRAP

.1 Manufacturers:
- .1 3M Canada Company Fire Master Duct Wrap 615
- .2 CL4 Fire Protection Thermal Insulation Quickwrap
- .3 Royal Quickstop
- .4 Other Manufacturers subject to shop drawing review

.2 Ductwork required to be fire-rated shall be greater than or equal to the minimum gauge listed for the design no., G-90 galvanized steel, wrapped with 3M Fire Master Duct Wrap 615 consisting of a 1-1/2" (38mm) thick non-combustible, flexible fireproof blanket, fully encapsulated in a foil scrim and supplied in roll form. The wrap material shall be applied directly onto the installed ductwork

strictly in accordance with the Manufacturer's instructions and the ULC Listing and Design No., Guide No. 40 U21, 'Fire Resistant Ducts', as tested to ISO Standard 6944.

3 Execution

3.1 INSTALLATION

.1 Install and seal ducts to SMACNA HVAC Duct Construction Standards - Metal and Flexible.

.2 Install ductwork parallel to building lines.

.3 Support all ductwork from structural members. Where structural bearings do not exist, suspend strapping or hangers from steel channels or angles. Provide supplementary structural members. Do not suspend from metal deck.

.4 Do not break continuity of insulation vapour barrier by hangers or rods.

.5 Hangers shall be steel angles with supporting rods, locking nuts and washers to following table:

Duct Size in. (mm)	Angle Size in. (mm)	Rod Size in. (mm)	Spacing ft. (mm)
<30 (750)	1x1x1/8 (25x25x3)	1/4 (6)	10.0 (3000)
31-42 (775-1050)	1-1/2x1-1/2x1/8 (38x38x3)	1/4 (6)	10.0 (3000)
43-60 (1050-1500)	1-1/2x1-1/2x1/8 (38x38x3)	3/8 (9)	10.0 (3000)
61-84 (1525-2100)	2x2x1/8 (50x50x3)	3/8 (9)	8.0 (2400)

.6 Anchor all risers at bottom and support from building structure at each floor level.

.7 Vertical ducts passing through floors shall be supported on angles secured to duct bearing on the floor.

.8 Where ducts pass through walls, floors, openings required to have a fire resistance rating the opening in the construction around the duct shall be filled with an approved fire stop material as per NFPA 90A and fire damper shall also be installed with access doors as per the code.

.9 Duct sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

.10 Provide openings in duct work where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

.11 Support risers in accordance with SMACNA.

.12 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

.13 Use crimp joints with or without bead for joining round duct sizes 8" (200mm) and smaller with crimp in direction of air flow.

.14 Use double nuts and lock washers on threaded rod supports.

.15 Connect terminal units to supply ducts directly or with 12" (300mm) maximum length of flexible duct. Do not use flexible duct to change direction.

.16 Connect diffusers or light troffer boots to low pressure ducts directly or with 60" (1.5m) maximum length of flexible duct held in place with strap or clamp.

.17 Connect flexible ducts to metal ducts with adhesive and metal or nylon straps.

.18 Ground across flexible connector with No. 2/0 braided copper strap.

.19 During construction provide temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.

.20 Balancing dampers shall be installed on branches as per locations shown on the Drawings and as per the requirements of NEBB and AABC listing/measuring standards.

.21 Perform duct leakage testing for all ductwork installed under this Contract.

.22 Paint all visible internal portions of duct outlets to grilles dull black. Internal painting of ductwork behind grilles shall be by Sheet Metal Contractor.

.23 Seams and penetrations in ductwork and plenums shall be sealed in accordance with seal classifications as described in SMACNA and ASHRAE.

.24 Do not begin air balance until system has been completed and is in full working order. Put all heating, ventilating, and air conditioning system and equipment into full operation and continue the operation of same during each working day of balancing procedures. Provide assistance to the Testing and balancing Agency as required.

3.2 CORRIDOR PENETRATION DUCTWORK

.1 Site measurements shall be taken before fabrication in the factory shall begin.

.2 The ductwork, joints, hangers, access doors and all other accessories shall be manufactured and installed as per Manufacturer's instructions and in accordance with the ULC listing, meeting the requirements of NFPA 96.

.3 The final installation shall be inspected and approved by the duct Manufacturer. Contractor to submit letters from Manufacturer to authority having jurisdiction verifying undertaking to inspect and final approval.

3.3 FIRE RATED DUCT WRAP

.1 Ductwork required to be fire-rated shall be minimum 24ga., G-90 galvanized steel, wrapped with 3M Fire Master Duct Wrap 615 consisting of a 1-1/2" (38mm) thick non-combustible, flexible fireproof blanket, fully encapsulated in a foil scrim and supplied in roll form. The wrap material shall be applied directly onto the installed ductwork strictly in accordance with the Manufacturer’s instructions and the ULC Listing and Design No., Guide No. 40 U21, 'Fire Resistant Ducts', as tested to ISO Standard 6944.

.2 Duct construction shall be as per ASHRAE and SMACNA using watertight construction. Hangers shall be threaded steel rod and angle iron cradles.

.3 One layer of wrap shall be applied to ductwork requiring a 1 hour fire resistance rating and two layers shall be applied to ductwork requiring a 2 hour fire resistance rating. Seams and joints to be lapped minimum 3" (75mm), taped and secured with steel banding. Tape and banding to comply with ULC listing and Manufacturer's instructions.

.4 All hangers, support rods, concrete anchors and fire stopping of duct penetrations through fire separations shall be in accordance with the ULC Listing and the Manufacturer's instructions.

3.4 FLEXIBLE DUCTWORK

.1 Flexible ductwork may be installed for final connections to air outlets provided that not more than 60” (1500mm) in length is used for each connection, and where specifically indicated on Drawings.

.2 All fittings used with flexible ductwork shall be rigid round duct.

.3 Use pre-insulated flexible ductwork where application is to be insulated.

3.5 DUCT CLEANLINESS

.1 All ductwork shall be handled and installed in accordance with the advanced level described in SMACNA Duct Cleanliness for New Construction Guidelines.

.2 After completing system installation including outlet fittings and devices, inspect the system.

.3 Ductwork leaving the premises of the manufacturer may include some or all of the following:

- .1 self-adhesive labels or marking for part(s) identification shall be applied to external surfaces only;
- .2 exposed mastic sealant;
- .3 light zinc oxide coating on the metal surface;
- .4 a light coating of oil on machine formed ductwork;
- .5 minor protrusions into the airway of rivets, screws, bolts and other jointing devices;
- .6 internal insulation and associated fasteners;
- .7 discoloration marks from plasma cutting process;
- .8 to maintain cleanliness during transportation, all ductwork shall be sealed either by blanking or capping duct ends, bagging small fittings, surface wrapping or shrink wrapping. Care must be taken to prevent damage during transportation and off loading.

.4 A clean and dry environment where the ductwork is protected from dust, must be provided for the storage of ductwork prior to installation. All sealed ends shall be visually examined and if damaged resealed with an appropriate material.

.5 During installation, the working area shall be clean, dry and the ductwork protected from dust.

.6 The internal surfaces of the un-insulated ductwork shall be wiped to remove excess dust immediately prior to installation.

.7 Open ends on completed ductwork and overnight work-in-progress shall be sealed.

.8 Access covers shall be firmly fitted in position on completion of each section of the work.

.9 Protective coverings shall only be removed immediately before installation and inspected to determine if additional wipe down is necessary.

3.6 DUCT LEAKAGE TESTING

.1 Ductwork shall be leak tested in accordance with the SMACNA "HVAC Air Duct Leakage Test Manual". The maximum permitted duct leakage shall be determined by multiplying the leakage factor by the surface area of the ductwork in the test zone.

.2 Ductwork that exceeds the maximum permitted leakage shall be re-sealed and re-tested.

.3 Duct leakage test shall be witnessed and certified by the Systems Verification Agency.

.4 Record and submit three copies of test results to the Consultant for review prior to application of duct insulation or concealment of ductwork.

END OF SECTION

1 General

1.1 SUMMARY

.1 Air turning devices/extractors
.2 Back draft dampers
.3 Duct access doors
.4 Duct test holes
.5 Fire dampers
.6 Flexible duct connections
.7 Volume control dampers
.8 Fire wrap
.9 Control dampers

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
.2 NFPA 92A - Smoke-Control Systems.
.3 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
.4 UL 33 - Heat Responsive Links for Fire-Protection Service.
.5 UL 555 - Standard for Fire Dampers.
.6 CAN/ULC-S112 - Fire Test of Fire-Damper Assemblies.
.7 CAN/ULC-S112.1 - Leakage Rated Dampers for Use in Smoke Control Systems.
.8 CAN/ULC-S112.2 - Fire Test of Ceiling Firestop Flap Assemblies.

1.4 SUBMITTALS

.1 Submit a ‘Letter of Conformance’, indicating the specified items selected for use in this Project with the following supporting product data reports.

.2 Shop Drawings for shop fabricated assemblies including balancing dampers, volume control dampers, duct access doors and duct test holes.

.3 Product Data for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.

.4 Manufacturer's Installation Instructions for fire dampers and combination fire and smoke dampers.

1.5 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: CSA Listed as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE AND PROTECTION

.1 Transport, handle, store, and protect products.

.2 Protect dampers from damage to operating linkages and blades.

1.7 EXTRA MATERIALS

.1 Provide two of each size and type of fusible link.

2 Products

2.1 AIR TURNING DEVICES / EXTRACTORS

.1 Turning vanes in rectangular duct elbows shall be double walled, multi-blade vanes with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps. Acceptable Products: Duro-Dyne "Duro Vane Rail", Hart & Cooley "Ducturn", Dyn-Air or Tuttle and Bailey.

.2 Volume extractors: gang operated curved blades, adjustable from full open to full closed positions. Units shall be factory assembled, fabricated from 14ga. and 22ga. (2 and 0.9mm) steel, with blades on 1" (25mm) centres, and No. 2 or No. 3 operators to suit application. Acceptable Products: Krueger model EX-8 indicated. EH Price Model AE1, Duro-Dyne, Dyn-Air or Hart & Cooley.

2.2 BACK DRAFT DAMPERS

.1 Gravity back draft dampers, Size 18" x 18" (450 x 450mm) or smaller, provided with air moving equipment: Air moving equipment Manufacturers standard construction.

.2 Multi-blade, parallel action gravity balanced back draft dampers: 1/16" (1.5mm) thick galvanized steel, or, with centre pivoted blades of maximum 6" (150mm) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90° stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 VOLUME CONTROL DAMPERS

.1 Factory fabricated with recognized hardware and accessories and to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.2 Splitter Dampers:

- .1 Material: Same gauge as duct to 24" (600mm) size in either direction, and two gauges heavier for sizes over 24" (600mm).
- .2 Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
- .3 Operator: Minimum 24" (600mm) diameter rod in self aligning, universal joint action, flanged bushing with set screw.

.3 Single Leaf Dampers: fabricated from minimum 20 gauge (1.0mm) galvanized steel, suitably reinforced to prevent vibration and fitted with indicating regulator. Duro-Dyne, Lawson & Taylor, Dyn-Air.

.4 Multi-Blade Opposed Action Dampers: fabricated from 16 gauge (1.6mm) galvanized steel, mounted in separate channel frames, reinforced to prevent vibration, and fitted with opposed action linkage hardware. Duro-Dyne "Opax" blade kit, Lawson & Taylor, Dyn-Air.

.5 End Bearings: Except in round ductwork 12" (300mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

.6 Quadrants:
- .1 Provide locking, indicating quadrant regulators on single and multi-blade dampers.
- .2 On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
- .3 Where rod lengths exceed 30" (750mm) provide regulator at both ends.

2.4 FIRE DAMPERS

.1 Manufacturers:
- .1 Ruskin Company
- .2 Nailor Industries Inc.
- .3 EH Price Ltd.
- .4 Others: Subject to shop drawing review.

.2 Fire dampers shall be ULC listed, labelled, meet all requirements of NFPA 90A, and constructed and rated in conformance with:
- .1 CAN/ULC-S112, "Fire Test of Fire-Damper Assemblies", when used in a fire separation of not more than 3 hours.
- .2 CAN/ULC-S112.2, "Fire Test of Ceiling Firestop Flap Assemblies", when used in a ceiling fire separation.
- .3 Fire dampers shall be galvanized steel channel frame curtain type galvanized steel interlocking blades, minimum 22 gauge (0.9mm) galvanized steel enclosure, and 160°F (71°C) fusible link standard.
- .4 Fire dampers for horizontal installation in vertical ductwork shall be operated by a stainless steel closure spring and latch.
- .5 Fire damper configuration shall be low resistance type B with blades located outside of the air stream for rectangular ductwork, and type C for round or oval ductwork.
- .6 Ceiling fire dampers shall be ULC labelled, for fire rated membrane type ceilings, galvanized steel construction with heat retardant blanket (non-asbestos) with standard 160°F (71°C) fusible link.
- .7 Thermal blanket shall be ULC labelled, for fire rated membrane type ceilings, to completely enshroud ceiling penetration.
- .8 Fire dampers in stainless steel ductwork shall be of all stainless steel construction.
- .9 Fusible Links: UL 33, separate at 160°F (71°C) with adjustable link straps for combination fire/balancing dampers.
- .10 Fire dampers listed for static systems shall be provided in ductwork where no air flow through the damper is expected such as in ductwork in HVAC systems that are automatically shut down in the event of a fire or for air transfer openings in walls or partitions.
- .11 Fire dampers listed for dynamic systems shall be provided in ductwork where the airflow is operational at the time of fire, such as in smoke control systems, or from other situations in which the fan system is operational at the time of a fire.

2.5 DUCT ACCESS DOORS

.1 Fabricate doors airtight and suitable for duct pressure and to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.2 Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated duct work, install minimum 1" (25mm) thick insulation with sheet metal cover.
- .1 Less Than 12" (300mm) Square: Secure with sash locks.
- .2 Up to 18" (450mm) Square: Provide two hinges and two sash locks.
- .3 Up to 24" x 48" (600 x 1200mm): Three hinges and two compression latches with outside and inside handles.
- .4 Larger Sizes: Provide an additional hinge.

.3 Access doors with sheet metal screw fasteners are not acceptable.

2.6 DUCT TEST HOLES

.1 Provide test ports to suit intended application, (i.e., Insulated / un-insulated duct, round/rectangular duct).

.2 Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

.3 Permanent Test Holes: Factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

.4 Acceptable Products: Air Power Co. Dial 1000, Dial 2000 or Duro-Dyne IP-1, IP-2, IPG-3, IP-4, Dyne-Air.

2.7 FLEXIBLE DUCT CONNECTORS

.1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.2 Connector: Fabric crimped into metal edging strip.
- .1 Fabric: UL listed fire-retardant neoprene coated woven glass fibre fabric to NFPA 90A, minimum density 1.0kg/m².
- .2 Net Fabric Width: Approximately 2" (50mm) wide.
- .3 Metal: 3" (75mm) wide, 1/32" (0.6mm) thick.

2.8 HANGERS AND SUPPORTS

.1 Fabricate strap hangers to same material as duct. Hanger configuration to SMACNA details. 20" (500mm) is maximum duct size to be supported by strap hanger.

.2 Rod and angle hangers: galvanized steel to SMACNA details.

.3 Hanger attachments: manufactured concrete inserts, expansion shields and bolted steel clamps. Do not weld rods to steel decks or use powder actuated fasteners.

2.9 FIRE PROTECTION DUCT WRAP

.1 Manufacturers
- .1 3M Canada Company Fire Master Duct Wrap 615.
- .2 CL4 Fire Protection Thermal Insulation Quickwrap.
- .3 Royal Quickstop.
- .4 Other manufacturers subject to shop drawing review.

.2 Ductwork required to be fire-rated shall be wrapped with 3M Fire Master Duct Wrap consisting of a 38mm (1-1/2") thick non-combustible, flexible fireproof blanket, fully encapsulated in a foil scrim and supplied in roll form. The wrap material shall be applied directly onto the installed ductwork Guide No. 40 U21, 'Fire Resistant Ducts', as tested to ISO Standard 6944.

2.10 DUCT LINING

.1 Fibre free duct lining.

2.11 FIRESTATS

.1 Manual reset safety devices designed to break line or control voltage contact for fans as air temperature reaches a predetermined level.

.2 Acceptable Products: Honeywell #L4029F, Johnson Controls, or Siemens.

2.12 DUCT SEALANT

.1 General: Low VOC, water based sealant, non-toxic, non-combustible, non-flammable, and tested in accordance with CAN4-S102-M83. Flame spread shall not exceed 25 and smoke developed shall not exceed 50.

.2 Acceptable Products: Multi-Purpose Duct Sealant as manufactured by Trans Continental Equipment, Duro Dyne SWB Duct Sealer, Iron Grip 601 as supplied by Alpha Sheet Metal Co., or Uni-Grip Duct Sealer from United McGill Corporation.

2.13 CONTROL DAMPERS

.1 Motorized dampers shall be sized as indicated. Maximum damper section shall be 1200mm x 1500mm (48” x 60”). For dampers larger than the section maximum, use an assembly of multiple, equally sized sections.

.2 Two-Position motorized dampers shall be parallel blade. Modulating motorized dampers shall be opposed blade. Exception: Parallel blade dampers may be used for return air and bypass application.

.3 Dampers shall be insulated at openings in the building envelope.

.4 Frames shall be constructed of extruded aluminum.

.5 Provide in-duct mounting dampers where shown on Drawings.

.6 Blades shall be extruded aluminum airfoil type.

.7 Blade seals shall be extruded EPDM. Frame seals shall be extruded silicone. Seals shall be secured in an integral slot within the aluminum extrusions. Blade and frame seals shall be mechanically fastened to eliminate shrinkage and

movement over the life of the damper. Adhesive or clip-on type blade seals shall not be acceptable.

.8 Maintenance free bearings shall be composed of a Celcon inner bearing fixed to an aluminum blade pivot pin, rotating within a polycarbonate outer bearing inserted into the frame. No metal to metal or metal to plastic contact.

.9 Drive rods, U bolt fasteners and retaining nuts shall be corrosion resistant zinc plated steel.

.10 All linkage hardware shall be installed on the frame side. All linkage crank arm and rod hardware parts shall be constructed of aluminum.

.11 Dampers shall be designed for operating in temperatures between -40ºC to 100ºC (-40ºF to 212ºF).

.12 Leakage shall not exceed 15 l/s/m² (2.95 cfm/ft²) against 250 Pa (0.036 psi) of differential pressure across fully closed damper when tested to AMCA Standard 511.

.13 Acceptable manufacturers are:
- .1 T.A. Morrison & Co. Inc (“Tamco)
- .2 Nailor Industries Inc.
- .3 Greenheck Fan Corporation
- .4 E.H. Price Ltd.
- .5 Ruskin Company

3 Execution

3.1 PREPARATION

.1 Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

.1 Install accessories to manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

.2 Provide back draft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

.3 Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8" x 8" (200 x 200mm) size for hand access, 18" x 18" (450 x 450mm) size for shoulder access, and as indicated. Provide 4" x 4" (100 x 100mm) for balancing dampers only. Review locations prior to fabrication.

.4 Provide duct test holes where indicated and required for testing and balancing purposes.

.5 Provide fire dampers, combination fire and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter

mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

.6 Install smoke dampers and combination smoke and fire dampers to NFPA 92A.

.7 Demonstrate re-setting of fire dampers to Owner's representative.

.8 Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment and supported by vibration isolators. For fans developing static pressures of 1250 Pa and over, cover connections with loaded vinyl sheet, held in place with metal straps.

.9 Use splitter dampers only where indicated.

.10 Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

.11 Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether they are shown on Drawings or not.

.12 Install control dampers in ducts or plenums as indicated.

.13 Install duct type smoke detectors in accordance with Manufacturer’s instructions where required in Division 26.

.14 Provide turning vanes where space restrictions prohibit the use of elbows having a minimum inside radius equal to the duct width for horizontal elbows or the duct depth for vertical elbows.

.15 Provide test ports as required by Balancing Agency and at inlet and outlet of fans, to completely test and balance the system. No temporary holes will be permitted in ductwork or flexible connections.

3.3 FIRE DAMPERS

.1 Provide fire dampers where shown on Drawings. In general, fire dampers are required where ducts pass through fire rated assemblies, floors and roofs and ducts entering and leaving duct shafts and mechanical rooms. Refer to architectural Drawings identifying wall fire ratings.

.2 Install fire dampers in strict accordance with Manufacturer's installation instructions and in conformance with NFPA 90A.

.3 Install type A fire dampers anywhere there are extreme space limitations and then only where dimension of duct exceeds 12" (300mm) in direction of blade closing and is specifically approved by Consultant.

.4 Install type B fire dampers for rectangular ductwork.

.5 Install type C fire dampers for round or oval ductwork.

.6 Openings for fire dampers must be properly prepared and the fire dampers installed and secured prior to field review by the Consultant. Notify the Consultant when ready for review. Do not make any duct connections to fire dampers until review is complete and work found correct.

.7 Support fire dampers from building structure. Submit erection Drawings, approved by all authorities, showing the locations and construction details of all fire dampers before proceeding with any work.

.8 Install ceiling fire dampers where ducts serve grilles and diffusers in rated ceilings. Support from building structure.

.9 Install thermal blanket in all fire rated membrane type ceilings. Thermal blanket shall be wrapped and stapled around the unexposed perimeter of diffuser after installation of ceiling damper following manufacturer's installation instructions.

3.4 DUCT ACCESS DOORS

.1 Provide duct access doors of suitable size in ductwork in the following locations:
- .1 Suction inlet of all fans
- .2 At not more than 12m intervals
- .3 At not more than 6m intervals on the ductwork installed after a high efficiency filter
- .4 At the base of all main risers
- .5 In front of and behind all turning vanes and coils
- .6 At all fire, smoke, and motorized dampers
- .7 At all locations having an internally mounted piece of equipment or device. Provide a section of transparent plexi-glass to permit viewing without opening the access doors
- .8 Where required for duct cleaning.

.2 Wherever possible, doors shall be mounted to close in direction of air flow.

3.5 FIRE PROTECTION DUCT WRAP

.1 Supply and install fire protection duct wrap on ductwork as indicated on Drawings in accordance with Manufacturer’s recommendations.

3.6 DUCT LINING

.1 Line internal surfaces of all ductwork, shown cross hatched on drawings with 1" (25mm) thick duct lining. Butt joints tightly together.

.2 Adhere lining to all sides of duct with minimum 50% coverage of flame resistant adhesive. Impale lining over welded pins on 12" (300mm) centres at top sections and sides and secure with speed washers.

.3 Repair damage to neoprene compound coating on duct liner incurred during installation by spraying or brush coating with approved similar compound.

.4 No allowance has been made in duct sizes indicated for internal lining. Increase duct size 1" (25mm) all around where lining is to be internally applied.

3.7 FIRESTATS

.1 Provide 135°F (57°C) firestats in return air ductwork of all supply units greater than 2000 cfm capacity.

.2 Provide 135°F (57°C) firestats in all exhaust systems greater than 2000 cfm capacity.

.3 Provide 235°F (112°C) firestats in discharge of all supply air units greater than 2000 cfm capacity.

.4 Wire firestats under this Section unless indicated otherwise in Mechanical-Electrical Schedule.

.5 Provide firestats in accordance with NFPA 90A.

3.8 CONTROL DAMPERS

.1 Provide control dampers for all exhaust fans, exhaust air louvres, air intake louvres, and wherever else shown on the Drawings.

.2 Install dampers in accordance with Manufacturer's Installation Instructions.

.3 Dampers must be accessible to allow inspection, adjustment, and replacement of components. The sheet metal contractor shall furnish any access doors in ductwork or plenums required to provide this access. The General Contractor shall furnish any access doors required in walls, ceilings, or other general building construction.

.4 Install dampers square and free from racking.

.5 The installing Contractor shall provide and install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.

.6 Do not compress or stretch the damper frame into the duct or opening.

.7 Attach multiple damper section assemblies together in accordance with Manufacturer's instructions. Install support mullions as reinforcement between assemblies as required.

.8 Handle dampers using the frame or sleeve. Do not lift or move dampers using blades, actuator or jackshaft.

.9 Install connections to actuators.

END OF SECTION

1 General

1.1 SUMMARY

.1 Roof exhausters.

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 AMCA 99 - Standards Handbook.
.2 AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
.3 AMCA 261 - Directory of Products Licensed to Bear the AMCA Certified Ratings Seal.
.4 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
.5 AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
.6 UL 705 - Power Ventilators.

1.4 SUBMITTALS

.1 Provide shop drawings and product data on fans and accessories including fan curves with specified operating point clearly plotted, sound power levels at rated capacity, and electrical characteristics and connection requirements.

.2 Manufacturer's Installation Instructions.

1.5 EXTRA MATERIAL

.1 Provide two sets of belts for each fan.

2 Products

2.1 ROOF EXHAUST FANS

.1 Manufacturers: Greenheck indicated as base design, or equivalent products by;
  .1 PennBarry
  .2 Loren Cook
  .3 Carnes Subject to shop drawing review

.2 Product Requirements:
  .1 Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
  .2 Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
  .3 Fabrication: Conform to AMCA 99.

.3 Performance: as scheduled on Drawings.

.4 Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2" (13mm) mesh, 0.08" (2mm) 16ga. aluminum bird screen; square base to suit roof curb with continuous curb gaskets.

.5 Roof Curb: 14" (350mm) high self flashing of aluminum with continuously welded seams, built in cant strips, and factory installed nailer strip.

.6 Electrical Characteristics and Components
- .1 Electrical Characteristics: as scheduled.
- .2 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.
- .3 Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.

.7 Back Draft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with nylon bearings.

.8 Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self aligning pre-lubricated ball bearings.

2.2 CEILING CENTRIFUGAL FANS

.1 Manufacturers: Greenheck indicated or equivalent products by;
- .1 PennBarry
- .2 Loren Cook
- .3 Carnes
- .4 Broan
- .5 Reversomatic

Subject to shop drawing review.

.2 Product Requirements:
- .1 Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
- .2 Sound Ratings: AMCA 301, tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.
- .3 Fabrication: Conform to AMCA 99.

.3 Performance: as scheduled on Drawings.

.4 Fan Unit: Direct driven, with spun acoustically insulated galvanized steel housing; resilient mounted motor; high impact polystyrene grille ; vibration isolation hangers, flexible inlet and/or outlet connections, non-chatter back draft damper and either a roof or wall termination as indicated.

.5 UL/cUL Classified ceiling radiation damper (fire flap) rated for 3 hours of fire resistance.

.6 Electrical Characteristics and Components
- .1 Electrical Characteristics: as scheduled.
- .2 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.

.3 Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.

3 Execution

3.1 INSTALLATION

.1 Install fans in accordance with Manufacturer's instructions.

.2 Provide flexible duct connections between each fan and ductwork. Ensure metal bands of connectors are parallel with minimum 1" (25mm) flex between ductwork and fan while running.

.3 Provide sheaves as required for final air balance.

.4 Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

.5 Roof exhaust fans;
- .1 Secure roof exhausters with stainless steel lag screws to roof curb.
- .2 Extend ducts to roof exhausters into roof curb. Counter flash duct to roof opening.
- .3 Install motorized back draft dampers on inlet to roof and wall exhausters.

.6 Cabinet & Ceiling Exhaust fans;
- .1 Support exhaust fans independently of ductwork.

END OF SECTION

1 General

1.1 SUMMARY

.1 De-stratification (HVLS) fans.

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 AMCA 99 - Standards Handbook.
.2 AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
.3 AMCA 261 - Directory of Products Licensed to Bear the AMCA Certified Ratings Seal.
.4 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
.5 AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
.6 UL 705 - Power Ventilators.
.7 National Fire Protection Association (NFPA).
.8 Canadian Standards Association (CSA).
.9 National Electrical Manufacturers Association (NEMA).
.10 National Electrical Code (NEC).
.11 Occupational Safety and Health Administration (OSHA).
.12 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
.13 Air Movement and Control Association (AMCA).

1.4 SUBMITTALS

.1 Provide shop drawings and product data on fans and accessories including fan curves with specified operating point clearly plotted, sound power levels at rated capacity, and electrical characteristics and connection requirements.

.2 Manufacturer's Installation Instructions.

.3 Ceiling fan sizing, placement, and performance shall be verified using computational fluid dynamics (CFD) analysis. At a minimum, the input data for the CFD analysis shall include the ceiling fan(s), significant obstructions to airflow at the floor level, and the actual space dimensions. As verification of performance, the submittal shall include results of the CFD analysis including, at a minimum, the following performance metrics determined in accordance with ANSI/ASHRAE Standard 55-2017: average air speed, minimum, maximum, and average cooling effect from elevated air speed, Predicted Mean Vote, and Predicted Percentage Dissatisfied for seated and standing occupants in each occupied zone.

1.5 QUALITY ASSURANCE

.1 Certifications.
- .1 The fan assembly, as a system, shall be Intertek/ETL-certified and built pursuant to the guidelines set forth by UL standard 507 and CSA standard 22.2 No. 113.
- .2 The fan shall be compliant with NFPA 13 - Standard for the Installation of Sprinkler Systems, NFPA 72 - National Fire Alarm and Signaling Code, and NFPA 70 - National Electrical Code (NEC).
- .3 Controllers shall comply with National Electrical Code (NEC) and Underwriters Laboratory (UL) standards and shall be labeled where required by code.

.2 Manufacturer Qualifications
- .1 The fan and any accessories shall be supplied by Big Ass Fans, which has a minimum of 15 years of product experience.
- .2 ISO 9001 compliant.
- .3 The manufacturer shall not be listed on the Air Movement and Control Association International Inc. (AMCA) Certified Ratings Program (CRP) Non-Licensed Products report in the previous 36 months.

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.

2 Products

2.1 HIGH VOLUME LOW SPEED / DE-STRATIFICATION (HVLS) FANS

.1 Manufacturer: Big Ass Fans Company indicated as base design, or equivalent products by:
- .1 Greenheck
- .2 Banvil

subject to shop drawing review.

.2 Complete Unit
- .1 Regulatory Requirements:
  - .1 The entire fan assembly shall be Intertek/ETL-certified and built pursuant to the construction guidelines set forth by UL standard 507 and CSA standard 22.2 No. 113.
  - .2 The digital wall controller shall be compliant with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) The device may not cause harmful interference, and (2) The device must accept any interference received, including interference that may cause undesirable operation.
- .2 Sustainability Characteristics:
  - .1 The fan shall be designed to move an effective amount of air for cooling and destratification in a variety of applications (including industrial, commercial, and agricultural) over an extended life. The

fan components shall be designed specifically for high volume, low speed fans to ensure lower operational noise.

.2 The digital wall controller shall be designed to control Big Ass Fans from a secure, centralized location, and shall be designed specifically for high volume, low speed Big Ass Fans to ensure maximum control.

.3 Good workmanship shall be evident in all aspects of construction. Field balancing of the airfoils shall not be necessary.

.3 Variable Frequency Drive (VFD)

.1 The onboard VFD shall be pre-wired to the motor and factory-programmed to minimize starting and braking torques for smooth and efficient operation.

.2 The VFD shall be pre-wired to the motor using a short run of flexible conduit with a dedicated ground conductor to minimize electromagnetic interference (EMI) and radio frequency interference (RFI).

.3 The VFD shall include a quick disconnect feature to allow for easy replacement of the drive.

.4 A 15’ (4.6m) incoming power cord shall be pre-wired to the VFD.

.5 The VFD shall be housed in a sealed, IP66-rated aluminum enclosure for protection in harsh environments.

.6 The VFD shall have an operating temperature of up to 131°F (55°C) ambient conditions.

.7 The VFD and digital wall controller shall communicate over a wired connection using Modbus communication protocol.

.8 The VFD shall be capable of integration with building automation systems.

.9 The VFD shall be equipped with the most current firmware version, and the VFD firmware shall be subject to updates without notice.

.10 The VFD shall include an embedded accelerometer with precise rotor control sensing to instantly detect impacts and obstructions and automatically shut down the fan.

.4 Fire Control Panel Integration

.1 Includes a 10–30 VDC pilot relay for seamless fire control panel integration. The pilot relay can be wired Normally Open or Normally Closed in the field.

.5 Motor

.1 The fan motor shall be a permanent magnet brushless motor rated for continuous operation at maximum speed with the capability of modulating the fan speed from 0–100% without the use of a gearbox or other mechanical means of control. No other motor shall be accepted.

.2 The motor shall be totally enclosed and rated IP66.

.3 The motor frame shall be designed for ease of service.

.4 The motor shall be manufactured with a double baked Class F insulation and shall be capable of continuous operation in -4°F to 131°F (-20°C to 55°C) ambient conditions.

.5 The motor shall operate from any voltage ranging from 200–277 VAC, single or three-phase, 50/60 Hz or 380–480 VAC, three-phase, 50/60 Hz without requiring adapters or customer selection.

.6 Airfoil system
- .1 The fan shall be equipped with six Powerfoil airfoils of precision extruded aluminum alloy. The airfoils shall be connected by means of two high strength locking bolts per airfoil. The airfoils shall be connected to the hub and interlocked with zinc plated steel retainers. All airfoil hardware shall be SAE Grade 8 or equivalent.
- .2 The fan shall be equipped with six Powerfoil winglets on the ends of the airfoils. The winglets shall be molded of a polypropylene blend. The standard color of the winglets shall be “Safety Yellow.”
- .3 Airfoil Restraint System
  - .1 All 20’ to 24’ (6 to 7.3m) diameter fans shall be equipped with a patented airfoil restraint system to provide redundant safety between the ends of the airfoils and the fan hub. The airfoil restraint system shall be available as an option on smaller diameter fans.
  - .2 The airfoil restraint system shall be comprised of durable, lightweight nylon safety straps that shall extend from winglets through the airfoils and secure to the fan hub with 12-gauge stamped steel safety clips.
  - .3 The straps shall be made of 1” (24mm) wide heavy-duty nylon webbing rated for 825lb (374kg). The loops at the ends of the straps shall be secured in a double-stitch pattern for reinforced durability.
  - .4 The straps shall be precisely matched to each fan’s diameter, eliminating the need for a tensioning mechanism and reducing the opportunity for noise.
  - .5 The straps shall run along the inside of the airfoils for an uninterrupted look.
  - .6 Safety clips shall be pre-attached to each winglet at the factory to comprise the outer anchor points and provide tension, while clips on the opposite end shall secure to threaded inserts incorporated in the fan hub.

.7 Mounting post
- .1 The fan shall be equipped with a mounting post that provides a structural connection between the fan assembly and extension tube. The mounting post shall be formed from A36 steel, contain no critical welds, and be powder coated for corrosion resistance and appearance.

.8 Mounting system
- .1 The fan mounting system shall be designed for quick and secure installation on a variety of structural supports. The design of the upper mount shall provide two axes of rotation to allow for adjustments to be made after installation on the mounting structure to ensure the fan will hang plumb.
- .2 The upper mount shall be of ASTM A-36 steel, welded construction, at least 3/16” thick, and powder coated for appearance and corrosion resistance. No mounting hardware or parts substitutions, including cast aluminum, are acceptable.
- .3 All mounting bolts shall be SAE Grade 8 or equivalent.

.9 Hub

.1 The fan hub shall be 19” (480mm) in diameter and shall be made of precision cut aluminum for high strength and light weight. The hub shall consist of two aluminum plates, six aluminum spars, and one aluminum spacer. The overall design shall provide a flexible assembly such that force loads experienced by the hub assembly shall be distributed over a large area to reduce the fatigue experienced at the attachment point for the fan blade.

.2 The hub shall be secured to the output shaft of the motor by means of one aerospace grade lug nut. The hub shall incorporate three safety retaining clips made of 1/4” (6mm) thick steel that shall restrain the hub/airfoil assembly.

.10 Safety cables

.1 The fan shall be equipped with an upper safety cable that provides an additional means for securing the fan assembly to the building structure. The upper safety cable shall have a diameter of 3/8” (10mm).

.2 The fan shall be equipped with two lower safety cables pre-attached to the motor that shall provide an additional means of securing the fan to the extension tube. The lower safety cables shall have a diameter of 3/8” (10mm).

.3 The safety cables shall be fabricated out of 7 x 19 galvanized steel cable. The end loops shall be secured with swaged Nicopress® sleeves, pre-loaded and tested to 3,200 lbf (13,345 N).

.4 Field construction of safety cables is not permitted.

.11 Digital Variable Speed Wall Controller

.1 The fan shall be equipped with a digital variable speed wall controller. The controller user interface shall be a wall-mounted, touch interface.

.2 The controller shall be mounted to a standard rectangular or square outlet box.

.3 A 150’ (45.7m) CAT5 cable shall be provided for connecting the controller to the fan’s VFD and to provide power to the controller.

.4 The controller mounting location shall meet the requirements of OSHA standard 29 CFR 1910.303(g) for accessibility minimum clearances.

.5 The controller shall have an IP65 rating.

.6 The controller shall provide fan start/stop, speed, and direction control functions.

.7 The controller shall provide diagnostic and fault history information for the connected fan, as well as the ability to configure fan parameters with the assistance of Big Ass Fans Customer Service.

.8 The controller interface shall be able to be secured with a passcode to prevent unauthorized access to fan controls and settings.

.9 The controller shall operate out of the box without setup and upon connection to CAT5 cable.

.12 BAFCon Controller

.1 The fan shall have the option of operating with the BAFCon controller.

.2 The digital controller user interface shall be a wall-mounted touchscreen with a 5” (127mm) display and an 800 (RGB) x 480 pixel resolution.

.3 The digital controller shall be mounted to a standard rectangular or square outlet box.
.4 A 150’ (45.7m) CAT5 cable shall be provided for connecting the digital controller to the fan’s VFD, allowing for seamless communication between BAFCon and the VFD. The cable shall provide power to the digital controller.
.5 The digital controller shall not require a 120 V power supply at the controller mounting location.
.6 The digital controller mounting location shall meet the requirements of OSHA standard 29 CFR 1910.303(g) for accessibility minimum clearances.
.7 The digital controller shall support up to eight Powerfoil D fans controlled as a group or individually.
.8 The digital controller shall provide fan start/stop, speed, and direction control functions.
.9 The digital controller shall provide diagnostic and fault history information for each connected fan as well as the ability to configure fan parameters with the assistance of Big Ass Fans Customer Service.
.10 The digital controller shall include optional SmartSense functionality to maximize energy savings. SmartSense shall provide the capability to automatically control the speed of Big Ass Fans using information from user-determined settings and built-in temperature and humidity sensors.
.11 The digital controller interface shall be able to be secured with user and admin passcodes to prevent unauthorized access to fan controls and settings.
.12 The digital controller shall include Bluetooth® functionality for receiving firmware updates from a mobile app. The app shall be supported by iOS® and Android™ mobile devices. The digital controller’s Bluetooth functionality can be disabled if not needed or permitted.
.13 BAFCon Multi-Fan Accessory Kit
.1 If multiple fans will be installed, the BAFCon Multi-Fan Accessory Kit shall be included.
.2 The kit shall include a two-screw RJ45 terminal block, a ¼ Watt, 120 Ohm termination resistor, RJ45 pass through splitters, and split-gland cord grips for connecting multiple fans to the controller.

.13 Guy Wires
.1 Included for installations with extension tubes 4’ (1.2m) or longer to limit the potential for lateral movement.

3 Execution

3.1 INSTALLATION

.1 Install fans in accordance with Manufacturer's instructions.
.2 Preparation
.1 Fan location shall have a typical bar joist or existing I-beam structure from which to mount the fan. Additional mounting options may be available.
.2 Mounting structure shall be able to support weight and operational torque of fan. Consult structural engineer if necessary.

.3 Fan location shall be free from obstacles such as lights, cables, or other building components.
.4 Check fan location for proper electrical requirements. Consult installation guide for appropriate circuit requirements.
.5 Each fan requires dedicated branch circuit protection.
.6 The fan system and the fan controller shall be installed according to the instructions in the fan installation guide.
.7 Install a rectangular or square outlet box at the wall controller mounting location.
.8 For multi-fan installations with the BAFCon controller, ensure the appropriate accessory kit is included as described above. The kit shall be installed by a factory-certified installer according to the instructions included with the kit.

.3 Installation
.1 The fan and wall controller shall be installed by a factory-certified Installer according to the Manufacturer's installation guide, which includes acceptable structural dimensions and proper sizing and placement of angle irons for bar joist applications. Big Ass Fans recommends consulting a Structural Engineer for installation methods outside the Manufacturer's recommendation and a certification, in the form of a stamped print or letter, submitted prior to installation.
.2 Minimum Distances
.1 Airfoils shall be at least 10' (3m) above the floor.
.2 Installation area shall be free of obstructions such as lights, cables, sprinklers, or other building structures with the airfoils at least 2' (610mm) clear of all obstructions.
.3 The fan shall not be located where it will be continuously subjected to wind gusts or in close proximity to the outputs of HVAC systems or radiant heaters. Additional details are in the fan installation guide.
.4 In buildings equipped with sprinklers, including ESFR sprinklers, fan installation shall comply with all of the following:
.1 The maximum fan diameter shall be 24' (7.3m).
.2 The HVLS fan shall be centered approximately between four adjacent sprinklers.
.3 The vertical clearance from the HVLS fan to the sprinkler deflector shall be a minimum of 3' (0.9m).
.5 All HVLS fans shall be interlocked to shut down immediately upon receiving a waterflow signal from the alarm system in accordance with the requirements of NFPA 72 - National Fire Alarm and Signaling Code.
.6 Mount the wall controller to a flat, readily accessible surface that is free from vibration and away from foreign objects and moving equipment. The controller mounting location must meet the requirements of OSHA standard 29 CFR 1910.303(g) for accessibility minimum clearances.
.7 If the SmartSense feature will be used, the BAFCon controller must not be mounted adjacent to or above a radiant heat source, near HVAC ventilation intakes/exhausts, on a poorly insulated exterior wall, or in a different temperature/humidity environment than the fan(s) it will control. Additional mounting guidelines can be found in the controller installation guide.

END OF SECTION

1 General

1.1 SUMMARY

.1 Single duct variable volume units.
  .1 Integral sound attenuator.
  .2 Integral damper motor operators.
  .3 Integral controls.

.2 Air curtain heaters.

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 ADC 1062 - Air Distribution and Control Device Test Code.
.2 NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
.3 UL 181 - Factory-Made Air Ducts and Connectors.

1.4 SUBMITTALS

.1 Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.

.2 Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalogue performance ratings which indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.

.3 Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of 250 to 1000 Pa.

.4 Manufacturer's Installation Instructions: Indicate support and hanging details, and service clearances required.

1.5 QUALITY ASSURANCE

.1 Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years documented experience.

1.6 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

1.7 WARRANTY

.1 Provide 5 year warranty.

.2 Warranty: Include coverage of system powered control systems.

1.8 DELIVERY, STORAGE AND PROTECTION

.1 Provide two additional electric motors of each size.

2 Products

2.1 SINGLE DUCT TERMINAL UNITS

.1 Provide variable air volume (VAV) box terminals where shown on Drawings, complete with 900mm long attenuator. Terminal inlet sizes and minimum/ maximum airflow shown on Drawings.

.2 Manufacturers:
- .1 EH Price products indicated, model SPD.
- .2 Other acceptable Manufacturers offering equivalent products.
  - .1 Titus
  - .2 Krueger
  - .3 Nailor
- .3 Substitutions: Subject to shop drawing review.

.3 Basic Assembly:
- .1 Casings: Minimum 22 ga. (0.8mm) galvanized steel.
- .2 Lining: Minimum 1/2" (13mm) thick neoprene or vinyl coated fibrous glass insulation, 24 g/L density, meeting NFPA 90A requirements and UL 181 erosion requirements.
- .3 Plenum Air Inlets: Round 22ga. (0.8mm) stub connections for duct attachment.
- .4 Plenum Air Outlets: A slip and drive connections.

.4 Basic Unit:
- .1 Configuration: Air volume damper assembly inside unit casing. Locate control component inside protective metal shroud.
- .2 Volume Damper: Construct of galvanized steel with peripheral gasket and self lubricating bearings; maximum damper leakage: 2% of design air flow at 0.25 kPa inlet static pressure.
- .3 Mount damper operator to position damper normally open.
- .4 Attenuator Section: Line attenuator sections with 1" (25mm) thick fibre free foam insulation.
- .5 Multi Outlet Attenuator Section: With 6" (150mm) diameter collars, each with butterfly balancing damper with lock.
- .6 Round Outlet: Discharge collar matching inlet size.
- .7 Damper Operator: electronic
- .8 Thermostat: Electronic type with appropriate mounting hardware.

2.2 AIR CURTAIN HEATERS

.1 Manufacturer:
- .1 Mars products are basis of design, refer to schedules on Drawings.
- .2 Other acceptable Manufacturers subject to equivalent products.
  - .1 Berner
  - .2 Miniveil
  - .3 Biddle
  - .4 Substitutions: Subject to shop drawing review.

.3 Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for 100 psi (1380 kPa) and 220°F (104°C).
.4 Cabinet: 0.0598" (1.5mm) steel with exposed corners and edges rounded, easily removed panels, glass fibre insulation and integral air outlet and inlet grilles.
.5 Finish: Factory applied baked enamel of colour as selected on visible surfaces of enclosure or cabinet.
.6 Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
.7 Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.
.8 Control: Multiple speed switch, factory wired, located in cabinet.
.9 Filter: Easily removed 1" (25mm) thick glass fibre throw-away type, located to filter air before coil.
.10 Mixing Dampers: Where indicated, mixing sections with dampers.
.11 Mounting bracket.
.12 Door limit switch.
.13 Capacity: As Scheduled, based on 65°F (18°C) entering air temperature, 180°F (82°C) average water temperature.
.14 Electrical Characteristics: as scheduled.

3 Execution

3.1 INSTALLATION

.1 Install to Manufacturer's instructions.

.2 Provide ceiling access doors or locate units above easily removable ceiling components.

.3 Support units individually from structure. Do not support from adjacent ductwork.

.4 Connect to ductwork.

.5 Install heating coils where indicated on Drawings.

.6 Verify that electric power is available and of the correct characteristics.

3.2 ADJUSTING

.1 Adjust work as required to meet the design intent.

.2 Reset terminal box volume with damper operator attached to assembly allowing flow range modulation from 100% of design flow to 0% full flow. Set minimum airflow to 40%. Set units with heating coils for a minimum 50% full flow.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00
.3 Section 23 31 00
.4 Section 23 33 00

1.2 REFERENCE STANDARDS

.1 Air Movement and Control Association (AMCA):
  .1 AMCA Publication 511, Product Rating Manual for Air Control Devices.

.2 Air Conditioning, Heating, and Refrigeration Institute (AHRI):
  .1 ANSI/AHRI 885, Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

.3 American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
  .1 ANSI/ASHRAE 36B-63, Method of Testing for Rating the Acoustic Performance of Air Control and Terminal Devices.
  .2 ASHRAE Standard 70, Method of Testing for Rating the Performance of Air Outlets and Inlets.

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
  .1 SMACNA, HVAC Duct Construction Standards - Metal and Flexible.

.5 Ontario Building Code (OBC)

1.3 SUBMITTALS

.1 Shop Drawings:
  .1 Provide submittals in accordance with Section 01 33 00.
  .2 Submit product literature for all equipment in this Section.

.2 Colour Chart(s): Submit Manufacturer's colour chart(s) for all items for which a finish colour is to be selected.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00.

.2 Deliver materials to site in original factory packaging, labelled with the Manufacturer's name and address.

.3 Separate for reuse and recycling and place in designated containers Steel, Metal and Plastic waste in accordance with Waste Management Plan (WMP).

.4 Store at temperatures and conditions recommended by the Manufacturer.

2 Products

2.1 GENERAL

.1 Grilles, registers, and diffusers for inlets to exhaust and return air system and as outlet for supply air systems shall be sized shown on the Contract Drawings.

.2 Refer to the Grilles and Diffusers Schedule at the end of this Section.

.3 Where special colour finish or material is noted submit samples for the Consultant selection. Refer to the Contract Drawings for model and capacity.

.4 Select all diffusers to provide uniform air coverage without overlap. Air velocity up to a height of 1800mm (6') above the floor shall be 0.127 to 0.254 m/s (25 to 50 fpm).

.5 Noise generated by diffusers shall be such that room sound pressure level does not exceed NC 32 with an 8db room attenuation, the sound power level reference to 10 to –12 power watts.

.6 Diffusers shall meet test requirements of ASHRAE Standard 36B-63, including air pattern and noise levels for air quantities from 10% to 110% of the required maximum air flow. Sound power tests shall be measured in accordance with ASHRAE Standards 36B-63.

.7 In gypsum board or plaster ceiling applications, provide matching mounting frame. Colour to match ceiling.

.8 In T-bar ceilings, manufacturer shall coordinate diffuser compatibility with T-bar ceiling specified by the architectural division. Colour shall match colour of ceiling tile in lay-in ceilings. Diffusers to suit ceiling grid as required imperial or metric.

.9 Acceptable manufacturers are:
- .1 E.H. Price Ltd.
- .2 Nailor Industries Inc.
- .3 Titus HVAC.
- .4 Krueger.

3 Execution

3.1 INSTALLATION OF DIFFUSERS, REGISTERS, AND GRILLES

.1 Provide grilles and diffusers where shown on the Drawings. Refer to the architectural Drawings for actual locations of diffusers, grilles and registers and install to suit. The mechanical drawings show intent and number of diffusers, grilles and registers required.

.2 Wherever possible, diffusers, registers, and grilles shall be the product of one Manufacturer. Unless otherwise specified connect diffusers, registers, and grilles in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible.

.3 Provide sheet metal plenums, constructed of the same material as the connecting duct, for linear grilles and/or diffusers where shown on the Contract Drawings. Construct and install the plenums in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible. Where

individual sections of linear grilles or diffusers are not equipped with a volume control device, equip the duct connection collar(s) with volume control device(s).

.4 Install in accordance with Manufacturer's instructions. Fit frame with gasket to prevent leakage and smudging. Install with flat head cadmium plated screws in countersunk holes where fastenings are visible.

.5 For exposed ductwork installations, all connections to grilles shall be oversized and shall have in-turned flanges to meet the flange of the grilles and the duct. Out-turned or exposed flanges with screw mounting shall not be accepted.

.6 For transfer air applications where air is transferred though a ceiling, partition or door provide grilles in all finished spaces. Provide transfer grille on both sides of the finished areas.

.7 Install mounting frame tied into plaster and gypsum board ceilings to allow lay in type diffusers to rest on the frame.

.8 Contractor shall caulk around edges of linear diffusers in installations with imperfect walls.

.9 Paint ductwork visible behind air outlets matte black.

.10 Confirm diffuser, register, and grille finishes prior to ordering.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 Comply with Section 20 01 00 and Section 20 05 00.

.2 Read and conform to:
- .1 The Contract CCDC 2, Stipulated Price Contract as amended in the Contract Documents;
- .2 Division 01 requirements and documents referred to therein.

1.2 SECTION INCLUDES

.1 Prefabricated Exhaust Hoods
.2 Remote Hood Control Panel
.3 Fire Suppression System

1.3 REFERENCES

.1 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
.2 NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
.3 NFPA 17A - Standard for Wet Chemical Extinguishing Systems.
.4 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
.5 ACGIH Industrial Ventilation.

1.4 SUBMITTALS

.1 Shop Drawings for prefabricated assemblies.

.2 Product Data for shop fabricated assemblies. Include electrical characteristics and connection requirements.

.3 Manufacturer's Installation Instructions.

1.5 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: CSA Listed as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE AND PROTECTION

.1 Transport, handle, store, and protect products.

2 Products

2.1 PREFABRICATED EXHAUST HOODS

.1 Basis of Design: Greenheck. Acceptable alternates subject to shop drawing review:
- .1 Halton.
- .2 Spring Air Systems.

.2 The Filter hood shall be UL/ULC listed and built in accordance with the NFPA-96.

.3 Exhaust hood shall be without exhaust damper.

.4 Filter type shall be one 500mm x 500mm (20” x 20”) stainless steel filter for 198 Lps (420 cfm) airflow rate.

.5 The unit casing shall be a minimum 18 GA. stainless steel on all exposed surfaces.

.6 The filter hood shall include UL/ULC listed VE baffle grease filter mounted in an integral stainless steel rack inclined at 45°. The filter rack shall include a full length stainless steel grease gutter and grease cup.

.7 The hood shall have 1 incandescent light evenly located along the length of the hood.

.8 Hood dimensions shall be 1065mm (42”) width x 1195mm (47”) depth x 584mm (23”) height.

.9 Refer to the mechanical and architectural Drawings for dimensions and clearances.

2.2 REMOTE HOOD CONTROL PANEL

.1 The commercial kitchen hood controller shall be a as indicated on the Drawing or approved equal subject to shop drawing review.

.2 The remote control panel shall be wall mounted, UL/ULC listed, with stainless steel enclosure and No. 4 brushed finish.

.3 The panel shall include exhaust fan ON/OFF switch and pilot lights, interlock for the unit ventilator, surface fire suppression system, and building fire alarm.

.4 Panel includes Thermal-Start option per requirements of IMC 2006; duct mounted J-couple assembly including mini-clips, j-box and UL/ULC duct penetration fitting supply by Greenheck and installed by Mechanical Contractor in main duct leading to exhaust fan, 30’ of J-couple wire including male and female mini-clip connectors, RPD panel mounted temperature processor set to auto activate exhaust fan at 90°F (32°C).

2.3 FIRE SUPPRESSION SYSTEM

.1 The surface fire suppression system shall be ANSUL with the indicated model in Drawings.

.2 The hood Manufacturer shall supply and install a wet chemical surface fire suppression system for the kitchen exhaust hood. The system shall be UL/ULC listed and supplied and installed in accordance with the NFPA-96, NFPA-17A and all applicable national and local code requirements.

.3 The fire suppression system shall be factory pre-piped to match the approved appliance lineup under each hood. Each appliance drop shall extend from the roof of the canopy to reduce grease accumulation on the interior canopy piping and simplify cleaning. Each drop and/or fitting in the canopy shall be chrome placed and connected to a UL/ULC hood penetration fitting. Each drop shall include, on the discharge end, a nozzle to suit the appliance being protected and a swivel fitting.

.4 The nozzles and fusible links shall be located to protect the appliances, hood plenum, and duct collar. The system shall be complete with two DPDT micro switches, a mechanical gas valve, wet chemical cylinder, and all necessary piping.

.5 A factory authorized Technician shall complete the final hookup on-site after the appliance has been set in place under the canopy.

.6 All remote wiring shall be by Division 26. The Electrical Contractor shall supply and install a shunt trip where electrical appliances are present and interlock the system with the building fire alarm panel.

3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions, NFPA 96, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible.

.2 Minimum distance from cooking appliance to lower front edge of hood shall be 1065mm (42”) to 1168mm (46”).

.3 Hood must overhang side of cooking appliance by at least 152mm (6”).

.4 Provide minimum 75mm (3”) clearance between the hood and the limited-combustible wall material, according to NFPA 96.

.5 Provide duct access doors for inspection and cleaning.

.6 Observe all necessary clearances.

.7 Make all necessary duct connections in accordance with NFPA 96, to satisfaction of authority having jurisdiction.

.8 Power wiring under Division 26.

END OF SECTION

1 General

1.1 SUMMARY

.1 Ductless split air conditioning systems.

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 Local and District By-Laws, Regulations and Published Engineering Standards.
.2 CAN/CSA - B52-92: Mechanical Refrigeration Code.

1.4 SUBMITTALS

.1 Product Data: Provide catalogue data indicating rated capacity, dimensions, and service connections, electric nameplate data and wiring diagrams.

.2 Shop Drawings: Indicate layout of system and components.

1.5 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 3 years documented experience.

1.6 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.7 WARRANTY

.1 Provide 5 year Manufacturer warranty for compressors.

2 Products

2.1 AIR CONDITIONING UNIT – SPLIT SYSTEM

.1 General: CSA or Ontario Hydro Inspection approved, UL or ULC tested, and ARI rated, and factory assembled with all controls installed, piped and wired.

.2 Provide a LG PACS4B000 AC smart central controller.

.3 Wall Cassette
  .1 General: unit shall be suitable for use as indicated. Unit shall be supplied complete with cabinet, evaporator coil, drain pan, refrigerant line connections, blower cooling relay, expansion valve kit, blower, disconnect switch, and filter section.
  .2 Capacities and Performance as shown on Drawings.

.4 Condensing Unit
  .1 General: constructed with heavy gauge enamelled steel cabinet, complete with control box, outdoor fan, compressor, outdoor coils, suction

line accumulator, expansion valve, crankcase thermostat, low ambient switch, high pressure switch, start controls, Hi-capacity two drier-check valve system, refrigerant line connections, electrical inlets and service valves, weatherproof disconnect switch, and insulated refrigerant line kit. (Less refrigerant)

.2 Capacities and performance as shown on Drawings.

.5 Condensate pump: provide a pump if draining by gravity is not possible.

.6 Equipment Warranty: The compressor shall have a limited warranty for a full 5 years. All other components shall have a limited Warranty for 1 year.

.7 Start Up: Provide the service of certified Manufacturer's representative during start-up and Owner's instruction.

.8 Manufacturer: LG models indicated.

.9 Acceptable alternates, subject to shop drawing review:
- .1 Sanyo
- .2 Carrier
- .3 Mitsubishi Electric
- .4 Daikin

3 Execution

3.1 INSTALLATION

.1 Install indoor unit in accordance with Manufacturer's installation instructions. Make all connections necessary.

.2 Install outdoor unit plumb and level on concrete pad or wall mounted as required, making all necessary piping connections.

.3 Install refrigerant line kits in accordance with Manufacturer's installation instructions.

.4 Refrigeration Equipment: prepare system for start-up by having Manufacturer's Field Engineer or factory trained representative supervise testing and charging of machines.

.5 Testing:
- .1 Provide sufficient refrigerant, dry nitrogen and refrigeration oil for pressure and operational testing under Manufacturer's supervision.
- .2 Prior to testing ensure that system is complete. Protect relief valves during test procedure. After completion of test, reconnect and make good piping connections and leak test entire system.

END OF SECTION

1 General

1.1 SUMMARY

.1 Packaged roof top unit.
.2 Unit controls.
.3 Roof mounting curb and base.
.4 Maintenance service
.5 Sequences of operations.

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00
.2 Section 20 05 00

1.3 REFERENCE STANDARDS

.1 ARI 210/240 - Unitary Air-Conditioning and Air Source Heat Pump Equipment.
.2 ARI 270 - Sound Rating of Outdoor Unitary Equipment.
.3 ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
.4 ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
.5 ASHRAE 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
.6 CSA-B149.1 - Natural Gas and Propane Code Handbook.
.7 NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
.8 NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

1.4 SUBMITTALS

.1 Section 20 01 00, Procedures for submittals.

.2 Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

.3 Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

.4 Section 20 01 00, Submittals for information.

.5 Submit Manufacturer's installation instructions. Indicate assembly, support details, connection requirements, and include start-up instructions.

.6 Section 20 01 00, Submittals for project closeout.

.7 Operation and Maintenance Data: Include Manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

1.5 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 3 years documented experience.

.2 ARI Compliance:

.1 Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.

.2 Comply with ARI 270 for testing and rating sound performance for RTUs.

.3 NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

1.6 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE AND PROTECTION

.1 Section 20 01 00, Transport, handle, store, and protect products.

.2 Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

1.8 WARRANTY

.1 Provide the following warranties:

.2 Compressor: 5 year

.3 Gas Heat Exchanger: 10 year

.4 Electric Heat Element: 5 year

.5 Other Parts: 1 year

1.9 MAINTENANCE SERVICE

.1 Section 20 01 00, Submittals for project closeout.

.2 Provide service and maintenance of packaged roof top units for 1 year from Date of Substantial Completion.

.3 Provide maintenance service with a two month interval as maximum time period between calls. Provide 24-hour emergency service on breakdowns and malfunctions.

.4 Include maintenance items as outlined in Manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments, and recalibration.

.5 Submit copy of service call work order or report and include description of work performed.

1.10 EXTRA MATERIALS

.1 Section 20 01 00, Submittals for project closeout.

.2 Provide one set of filters.

2 Products

2.1 GENERAL UNIT DESCRIPTIONS

.1 There are two types of rooftop units on this project. Refer to the schedules on the Drawings.
- .1 Variable Air Volume (VAV) Air Handling Systems - Packaged DX, gas-fired rooftop unit serving office block (RTU-1),
- .2 Energy Recovery Ventilation (ERV's) Air Handling Systems - Packaged/ modular, gas-fired rooftop unit, complete with heat recovery wheel serving the vehicle bay (RTU-2).

.2 Furnish and install package rooftop unit(s) as shown and scheduled on the Contract Documents. The unit(s) shall be installed in accordance with this Specification and perform at the specified conditions as shown on the as schedules and on the Contract Documents.

.3 Unit(s) shall be 100% factory run tested and fully charged with R-410A if DX cooling is used.

.4 Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.

.5 Units shall be dedicated downflow or dedicated horizontal airflow as manufactured.

.6 Wiring internal to the unit shall be colored and numbered for identification.

.7 Acceptable Manufacturers:
- .1 Basis of design "RTU-1" unit is as manufactured by Trane. Acceptable alternates, subject to shop drawing review are:
  - .1 Carrier
  - .2 York
  - .3 Lennox
- .2 Basis of design "RTU-2" unit is as manufactured by Trane. Acceptable alternates, subject to shop drawing review are:
  - .1 Aaon
  - .2 Daikin

2.2 VARIABLE AIR VOLUME (VAV) SYSTEMS

.1 VAV Unit(s) shall be multizone systems consisting of the following components:
- .1 Unit Casing: As specified in Section 2.4.
- .2 Fans and Motors: As specified in Section 2.4.
- .3 Gas Fired Heating Section: As specified in Section 2.4.
- .4 DX Refrigeration System: As specified in Section 2.4.
- .5 Return-air Filters: MERV rating as scheduled on Contract Documents.
- .6 Roof Curb: As specified in Section 2.4 of this Section.
- .7 Unit controls: BACNet control system capable communicating with all VAV boxes associated with each air handler and as specified in Section 2.6 of this Section.

.2 Provide, on downflow units above 7.5 tons, a factory supplied field installed power exhaust assembly in the Return/Exhaust Section that shall assist the barometric relief damper in the economizer in relieving building pressurization.

.3 VAV system units shall be provided with VFD (Variable Frequency Drive) on Indoor fan motor. VFD shall change fan speed according to mode of operation. The VFD shall receive a 0-10 Vdc signal from the unit controls based upon supply static pressure and shall cause the drive to accelerate or decelerate as required to maintain the supply static pressure setpoint. When subjected to high ambient return conditions the VFD shall reduce its output frequency to maintain operation.

2.3 VEHICLE BAY - ENERGY RECOVERY VENTILATION (RTU-2) SYSTEMS

.1 RTU-2 Unit shall be single zone systems consisting of the following components:
- .1 Unit Casing: As specified in Section 2.4.
- .2 Fans and Motors: As specified in Section 2.4.
- .3 Gas Fired Heating Section: As specified in Section 2.4.
- .4 Heat Recovery Wheel: As specified in Section 2.4.
- .5 Return-air Filters: MERV rating as scheduled on Contract Documents.
- .6 Roof Curb: As specified in Section 2.4.
- .7 Unit controls:
  - .1 ERV's (warehouse): Direct Digital Control (DDC) system as described in Section 2.8.

2.4 AIR HANDLING UNIT COMPONENTS

.1 Unit Casing
- .1 Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels. Structural members shall be 16 gauge with access doors and removable panels of minimum 20 gauge.
- .2 Units cabinet surface shall be tested 1000 hours in salt spray test in compliance with ASTM B117.
- .3 Cabinet construction shall allow for all service/maintenance from one side of the unit.
- .4 Cabinet top cover shall be one-piece construction or where seams exit, it shall be double-hemmed and gasket-sealed.
- .5 Access Panels: Water and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.
- .6 Downflow unit's base pans shall have a raised 1 1/8" high lip around the supply and return openings for water integrity.
- .7 Insulation: Provide ½" (12mm) thick coated fiberglass insulation on all exterior panels in contact with the return and conditioned air stream.
- .8 Provide openings either on side of unit or thru the base for power, control and gas connections.
- .9 The base of the unit shall have provisions for forklift and crane lifting.

.2 Fans and Motors
- .1 Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.

.2 Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.
.3 Provide units 12.5 tons and above with belt driven, supply fans with adjustable motor sheaves.
.4 Outdoor and Indoor Fan shall be permanently lubricated and have internal thermal overload protection.
.5 Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.
.6 Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
.7 Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.
.8 Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.
.9 Units with VFDs shall be provided with bypass mode operation. This operation is field wired to bypass VFD when required.
.10 Unit with VFDs shall be provided with shaft grounding rings for electrical protection. Shaft grounding rings provide long term motor/VFD bearing reliability.

.3 Gas Fired Heating Section
.1 Completely assembled and factory installed heating system shall be integral to unit, UL or CSA approved specifically for outdoor applications for use downstream from refrigerant cooling coils. Threaded connection with plug or cap provided. Provide capability for gas piping.
.2 Heating section shall be factory run tested prior to shipment.
.3 Gas Burner shall be forced combustion type power burner, negative pressure gas valve, manual shut-off, hot surface ignition, and flame sensing safety control.
.4 Gas Burner Safety Controls: Provide safety controls for the proving of combustion air prior to ignition, and continuous flame supervision. Upon a failure to ignite, two attempts of ignition will occur before lockout of the ignition system.
.5 Combustion blower shall be centrifugal type fan with built- in thermal overload protection on fan motor.
.6 Heat Exchanger: Provide drum and tube heat exchanger of free floating design manufactured from 18-gauge stainless steel, factory pressure and leak tested.
.7 Limit controls: High temperature limit controls will shut off gas flow in the event of excessive temperatures resulting from restricted indoor airflow or loss of indoor airflow.
.8 The gas shall have modulating control at a minimum of 2.5:1. Smaller units shall have single or two-stage heating, as noted in the schedule.
.9 Heat Capacity – as shown in schedules (10:1 Turndown natural gas)
.10 100% fresh air units as noted on the drawings and schedules (ERVs) modulation shall be 10:1 The heating section shall have a progressive tubular heat exchanger design using Stainless Steel burners and type 439 Stainless Steel tubes. An induced draft combustion blower shall be used to pull the combustion products through the firing tubes. The heater shall use a direct spark ignition (DS) system. On initial call for heat, the

combustion blower shall purge the heat exchanger for 20 seconds before ignition. After three unsuccessful ignition attempts, the entire heating system shall be locked out until manually reset at the thermostat/zone sensor. Units shall comply with the California requirement for low NOx emissions. Unit shall be suitable for use with Natural Gas. Minimum incoming gas pressure of 7" W.C. and Maximum pressure of 14" W.C. required. Factory provided 25-year heat exchanger warranty.

.4 DX Refrigeration System

.1 Compressor(s): Provide scroll compressor with direct drive operating at 3600 rpm. Integral centrifugal oil pump. Provide suction gas cooled motor with winding temperature limits and compressor overloads.

.2 Units shall have cooling capabilities down to 0oF as standard for field-installed low ambient accessory, the manufacturer shall provide a factory-authorized service technician that will assure proper installation and operation.

.3 Provide each unit with refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, suction and liquid line pressure ports.

.4 Evaporator Coil

.1 Provide configured aluminum fin surface mechanically bonded to copper tubing coil.

.2 Provide an independent expansion device for each refrigeration circuit. Factory pressure test at 450 psig and leak test at 200 psig.

.3 Provide drain pan for base of evaporator coil constructed of PVC with external connections.

.5 Condenser Section

.1 Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing.

.5 Heat Recovery Wheel/ Outdoor Air Section:

.1 Provide 100% return air section.

.2 Provide economizer with dry bulb temperature control.

.3 Provide adjustable minimum position control located in the economizer section of the unit.

.4 Provide spring return motor for outside air damper closure during unit shutdown or power interruption.

.5 <u>Energy Recovery (where noted on the schedule) - ERV-Aluminum Construction with Frost Protection w/ VFD:</u> Energy recovery wheel performance shall be AHRI 1060 certified and bear the AHRI certified label. The rotor media shall be light weight and must be made of aluminum. Paper or fibrous media are not acceptable. All surfaces must be coated with a nonmigrating adsorbent layer of desiccant prior to being formed into the media structure to ensure that all surfaces are coated, and that adequate latent capacity is provided. The desiccant must be a 3A molecular sieve designed for the adsorption of water vapor. The media shall be cleanable by vacuuming the media surface, without degrading the latent recovery. Dry particles up to 800 microns shall pass freely through the media.

.6 ERV Rotation sensor: Inductive Proximity Sensors detect metal objects without contact and are characterized by a long service life and extreme ruggedness. With the latest ASIC technology, the Manufacture's sensors offer the ultimate in precision and reliability. Their sensors are the intelligent, reliable route to implementing wheel rotation.

.6 Roof Curb

.1 Contractor shall provide factory supplied 14" (350mm) roof curb, 16 gauge perimeter made of zinc coated steel with supply and return air gasketing and wood nailer strips. Ship knocked down and provided with instructions for easy assembly.

.2 Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.

2.5 ELECTRICAL AND CONTROL REQUIREMENTS

.1 All unit(s) shall be provided with the following minimum requirements:

.1 Provide factory-wired roof top units with 24 volt control circuit with control transformers, contactor pressure lugs or terminal block for power wiring.

.2 Units shall have single point power connections with factory installed disconnect. Field wiring of zone controls to be NEC Class II.

.3 115-1 GFCI outlet shall be provided by the factory; field shall provide separate power circuit per code.

.4 Provide unit-mounted control microprocessor (UCM) and display panel which, when used with an electronic zone sensor and gas detection (if specified), provides proportional integral room control. This UCM shall perform all unit functions by making all heating, cooling, and ventilating decisions through resident software logic.

.5 Provide factory-installed indoor evaporator defrost control to prevent compressor slugging by interrupting compressor operation.

.6 Provide an anti-cycle timing and minimum on/off between stages timing in the microprocessor.

.7 Economizer Preferred Cooling (if supplied with economizer) - Compressor operation is integrated with economizer cycle to allow mechanical cooling when economizer is not adequate to satisfy zone requirements. Compressors are enabled if space temperature is recovering to cooling setpoint at a rate of less than 0.2 degrees per minute. Compressor low ambient lockout overrides this function.

2.6 VAV SYSTEM CONTROLLER/OPERATOR DISPLAY (OFFICE AREAS)

.1 Provide a BACnet field-level equipment controller and display for each VAV system to controller shall provide integrated control of:

.1 Rooftop unit (RTU).

.2 All VAV associated with the RTU.

.3 All washroom exhaust fans associated with the RTU.

.2 Basis of design system controllers are Tracer Concierge® as manufactured by Trane. Acceptable alternates, subject to shop drawing review are:

.1 i-Vu Controllers (for Carrier units)

.2 Johnson Controls (for York units)

.3 CONTROL SYSTEM OVERVIEW: Control System shall include a System Controller, all controllers for HVAC equipment and ancillary devices (such as lights, VAV terminals and exhaust fans), wireless communication between the System Controller, equipment controllers, and space sensors, and all wiring and end devices required. Control System to be fully programmed and commissioned by the installing Contractor.

.4 TOUCH SCREEN DISPLAY: Control System shall include a 10" color Touch Screen Display for use by building occupants to adjust zone temperature setpoints, override lighting and HVAC equipment for after-hours use, modify schedules, and view service notifications. This display shall have PIN access for users and provide setpoint adjustment limits.

.5 MOBILE APP: Control System Manufacturer shall provide a Mobile App for cellular devices to allow occupants to perform the same functions (listed above) as the Touch Screen Display.

.6 WEB BROWSER INTERFACE: System Controller shall have an embedded Web Browser Interface to allow the Installer and service providers to make adjustments to system control parameters and view trend logs and other service information.

.7 WIRED COMMUNICATION: The Control System shall be provided with wired communication between the System Controller, HVAC equipment controllers, and space sensors. This wired communication shall be based on BACnet MSTP or BACnet IP. Space sensors shall measure temperature, relative humidity, occupancy, and CO_2 per the equipment schedule. Multiple space sensors in larger spaces shall be averaged for control and individually monitored. Wireless communication is not acceptable.

.8 SYSTEM CONTROLLER: System Controller shall provide scheduling and coordination of all HVAC equipment, exhaust fans, and controlled lighting devices for devices associated with that VAV unit. The System Controller shall include a software application that coordinates the operation of rooftop units and VAV. The System Controller shall support multiple system types, including Single-Zone Constant Volume, Single-Zone VAV, Changeover Bypass, Changeover VAV, and Multiple-Zone VAV with Terminal Reheat (electric or hot water, as applicable). The System Controller shall provide energy optimization strategies including Night Setback, Optimal Start, Fan Pressure Optimization, Discharge Air Temperature Reset, and Demand-Controlled Ventilation.

.9 REMOTE ACCESS/NETWORK SECURITY: Installer shall provide secure remote access to the Control System to enable the owner or service provider to access the system remotely using the Mobile App or Web Browser Interface. The Control System must be secured behind a firewall and not allow any inbound ports to be open or exposed to the internet. Control System Manufacturer shall provide a remote access portal accessible by the Owner and/or a service provider as authorized by the Owner.

.10 As a back-up, provide programmable electronic microcomputer based zone control capable of staged controls.

.1 Zone control shall incorporate:

.1 Automatic changeover from heating to cooling.

.2 Set-up for at least 2 sets of separate heating and cooling temperatures per day.
.3 Instant override of setpoint for continuous or timed period from 1 hour to 31 days.
.4 Switch selection features including Fahrenheit display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.

.2 Zone sensor display shall be capable of:
.1 Time of day.
.2 Actual room temperature.
.3 Programmed temperature.
.4 Programmed time.
.5 Duration of timed override.
.6 Day of week.
.7 System mode indication: heating, cooling, low battery fan on.

.3 Provide remote temperature sensor capability.

.4 Provide mixed air sensor in supply air to close outside air damper.

2.7 VEHICLE BAY ERV SYSTEM CONTROLLER/OPERATOR DISPLAY

.1 Provide a BACnet field-level equipment controller and display for each for each ERV system. The system need only provide integrated control for the ERV.

.2 Basis of design system controllers are UC600 c/w TD7 Display as manufactured by Trane. Acceptable alternates, subject to shop drawing review are:
.1 AAON Touchscreen Controller (for AAON units)
.2 3rd Party Controls (for Daikin units)

.3 Provide programmable electronic microcomputer based zone control capable of staged controls.
.1 Zone control shall incorporate:
.1 Set-up for at least 2 sets of separate heating and cooling temperatures per day.
.2 Instant override of setpoint for continuous or timed period from 1 hour to 31 days.
.3 Switch selection features including Celsius and Fahrenheit display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.

.2 Zone sensor display shall be capable of:
.1 Time of day.
.2 Actual room temperature.
.3 Programmed temperature.
.4 Programmed time.
.5 Duration of timed override.
.6 Day of week.
.7 System mode indication: heating, low battery, fan on.

.3 Provide remote temperature sensor capability.

2.8 CONTROL DAMPER ACTUATORS

.1 Provide spring return actuators with control signal appropriate for the operation.

.2 Operating Time: Maximum 120 seconds throughout the full rotation.

.3 Angle of Rotation: Adjustable between 0° to 90°.

.4 Stall protection: Mechanical or electronic.

.5 Actuators shall have electronic overload protection or digital rotation sensing circuitry to prevent actuator damage throughout the entire rotation.

.6 Failsafe: Non-spring return for VAV terminals; spring return for other applications. Spring return to normal position within 15 seconds.

.7 Provide quantity of actuators to ensure sufficient torque for the damper. Total actuator torque must be 20% above the calculated damper torque.

.8 Position Indicator: Reversible for clockwise or counter-clockwise rotation; set the 0° mark to the failsafe position.

.9 Manual Override: Crank type. External gear release for non-spring return actuators.

.10 Torque: To damper manufacturer's requirements to provide complete compression of seals between frame and blades and for smooth control.

.11 Provide UL555S listed damper actuators for all dampers used in smoke control.

.12 Acceptable Manufacturers: Belimo Air Controls Inc., Johnson Controls Inc., Siemens Canada Inc., or Honeywell International Inc.

3 Execution

3.1 EXAMINATION

.1 Verification of existing conditions prior to beginning work.

.2 Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.

.3 Verify that proper power supply is available.

3.2 INSTALLATION

.1 Install to Manufacturer's instructions.

.2 Install to NFPA 90A NFPA 90B.

.3 Mount units on factory-built roof mounting curb and coordinate roof penetrations and flashing with roof construction. Secure RTUs and ERVs to upper curb rail, and secure curb base to roof structure with anchor bolts. Install roof mounting curb level.

.4 Insulate around the roof curb.

.5 Install condensate drain, minimum connection size, with trap and direct to nearest roof.

.6 Install ducts to termination at top of roof curb. Remove roof decking only as required for passage of ducts; do not cut out decking under entire roof curb.

.7 Connect gas piping to burner, full size of gas train inlet, with union and shutoff valve with sufficient clearance for burner removal and service.

.8 If building has Fire Alarm Panel, rooftop units shall automatically shut-off from building Fire Alarm Panel. Coordinate with Electrical Contractor.

.9 Locate remote panels where indicated.

3.3 MANUFACTURER'S FIELD SERVICES

.1 Prepare and start systems to Section 20 01 00.

.2 Provide initial start-up and shut-down during first year of operation, including routine servicing and check-out.

4 Sequences of Operation

4.1 GENERAL SEQUENCING REQUIREMENTS

.1 Occupied versus unoccupied modes shall be determined by a time of day schedule and space mounted occupancy sensors and shall be adjustable.

.1 Unoccupied

.1 Monday to Friday 21:00 to 06:00

.2 Saturday, Sunday and Holidays

.2 Occupied

.1 Monday to Friday 06:00 to 21:00

.3 All temperature setpoints shall be adjustable.

Area	Temperature Setpoints			
	Heating		Cooling	
	Unoccupied °C (°F)	Occupied °C (°F)	Unoccupied °C (°F)	Occupied °C (°F)
Office Area	21 (70)	22 (72)	26 (78)	24 (75)
Warehouse	18 (64) OBC	18 (64) OBC	n/a	n/a
Vehicle Bay	15 (60) ~18 (64)	15 (60) ~18 (64)	n/a	n/a

4.2 SEQUENCE OF OPERATION FOR VAV SYSTEMS (RTU-1)

.1 All control functions of the RTU and all other HVAC equipment serving the same spaces as the RTU (e.g., VAV Terminals, baseboard heaters, etc.) shall be handled by BACnet System Controller (Trane Tracer Concierge). The controller capable of performing control sequences as described herein. The system controller will be referred to as "BAS" hereafter.

.2 Unoccupied

.1 The supply air fan shall be disabled. A request for either heating or cooling shall enable the fan.

.2 The outdoor air and exhaust air dampers shall be in the closed position.

.3 The mixed air damper shall be in open position.

.4 Upon a request for heating, the air cooled condenser shall be disabled, and the auxiliary baseboard heaters shall be enabled (if provided on Drawing). If heating setpoint cannot be maintained by the baseboards

alone, the supply fan and natural gas fired heat exchanger shall modulate to maintain the discharge air temperature setpoint.

.5 Upon a request for cooling, the natural gas heat exchanger shall be disabled, and the air cooled condenser shall be modulate to maintain the discharge air temperature setpoint.

.3 Morning Warm-Up / Cool-Down

.1 The morning warm up and cool down cycles shall be bypassed when the outdoor air temperature is within 1°C (1.8°F) of the indoor air temperature.

.2 Warm-Up

.1 The outdoor air and exhaust air dampers shall remain in the closed position.

.2 The mixed air damper shall remain in the open position.

.3 The air cooled condenser shall be disabled.

.4 The supply fan shall be energized by the BAS at low speed and shall ramp up to maintain the duct static pressure as measured by the remote duct static pressure sensor.

.5 The BAS shall simultaneously modulate all supply air variable volume boxes to the 70%, adjustable, open position.

.6 The natural gas fired heat exchanger shall modulate to maintain the discharge air setpoint temperature. The BAS shall generate an alarm if the supply air temperature exceeds 49°C (120°F) and revert to the unoccupied mode.

.7 When the return air temperature rises to the setpoint temperature, as measured at the return air temperature sensor. The system shall operate for 10 minutes, adjustable, afterward. After which time the unit shall switch to the normal occupied mode.

.3 Cool-Down

.1 The outdoor air and exhaust air dampers shall remain in the closed position.

.2 The mixed air damper shall remain in the open position.

.3 The natural gas fired heat exchanger shall be disabled.

.4 The supply fan shall be energized by the BAS at low speed and shall ramp up to maintain the duct static pressure as measured by the remote duct static pressure sensor.

.5 The BAS shall simultaneously modulate all supply air variable volume boxes to the 70%, adjustable, open position.

.6 The air cooled condenser shall modulate to maintain the discharge air setpoint temperature. The BAS shall generate an alarm if the supply air temperature drops below 10°C (50°F) and revert to the unoccupied mode.

.7 When the return air temperature drops to the setpoint temperature, as measured at the return air temperature sensor. The system shall operate for 10 minutes, adjustable, afterward. After which time the unit shall switch to the normal occupied mode.

.4 Occupied

.1 The BAS shall modulate the outdoor air, exhaust air and mixed air dampers, the air cooled condenser and natural gas heat exchanger, in

sequence to minimize the energy requirements based on the space, return and outdoor air temperatures.

.2 Upon a request for heating, the air cooled condenser shall be disabled, if heating setpoint cannot be maintained by the discharge air temperature of RTU, the auxiliary baseboard heaters shall be enabled (if provided on Drawing).

.3 The supply fan speed shall be adjusted by the duct mounted static pressure sensors.

.4 A carbon dioxide (CO_2) sensor shall be provided in the return air duct and the outdoor intake. When the CO_2 differential concentration exceeds 400ppm, adjustable, the BAS shall modulate the outdoor and exhaust air dampers to increase the ventilation air through the unit. When the differential concentration drops below 300ppm, adjustable, the dampers shall return to the pre-event positions.

.5 If the outdoor air temperature is between 4°C (39°F) and 18°C (64°F), adjustable, the CO_2 controls shall be bypassed. The BAS shall modulate the outdoor air, exhaust air, and mixed air dampers to provide an economizer mode.

.5 Status:

.1 Display ON/OFF

.6 Alarms:

.1 Fan off when commanded on.

.2 Fan on when commanded off.

.3 CO_2 differential concentration exceeds 500 ppm.

.4 Filters require replacement.

.7 Variable Air Volume (VAV) Terminal Boxes

.1 General

.1 Variable air volume air flow settings indicated on the Drawings are the ventilation (minimum) airflow during occupied hours and the maximum cooling airflow.

.2 An indoor air quality sensor (1 per terminal box) shall be provided in the critical space served by the terminal box. Upon sensing a CO_2 concentration differential between the space and the outdoor air quality sensor of 400 ppm, adjustable, the corresponding terminal box shall be modulated to the fully open position. When the concentration drops below 300 ppm, adjustable, the dampers shall return to the pre-event positions.

.2 Unoccupied

.1 The terminal box damper shall be in the closed position.

.2 The terminal box damper shall modulate to the minimum position or greater to maintain the space setup temperature.

.3 Occupied

.1 The terminal box damper shall modulate to the minimum position or greater to maintain the space setpoint temperature.

4.3 SEQUENCE OF OPERATION FOR VEHICLE BAY ERV SYSTEMS (RTU-2)

.1 This sequence applies only to vehicle bay area where fuel fired vehicles are present.

.2 Vehicle area is divided in three zones, every zone has 2 roof fans and 4 wall louvers, respectively.

.3 During Normal COx-NOx levels:
- .1 Unoccupied
  - .1 Roof Exhaust Fans (REF-1 to REF-6) shall be disabled.
  - .2 The supply air and exhaust air fans of the ERV units shall be disabled. A request for heating shall enable the fans.
  - .3 The outdoor air and exhaust air dampers of ERV units shall be in the closed position.
  - .4 Upon a request for heating, should the gas-fired heaters not respond to meet demand, the energy recovery wheel and the natural gas fired heat exchanger shall modulate to maintain the discharge air temperature setpoint of 15°C.
  - .5 Gas-fired unit heaters shall provide primary heating during unoccupied hours. These units shall provide stage 1 heating (thermostats set to 18°C) and the ERV is stage 2 heating (thermostats set to 15°C).
- .2 Occupied
  - .1 Roof Exhaust Fans (REF-1 to REF-6) shall be disabled.
  - .2 The supply air and exhaust air fans of ERV units shall be enabled.
  - .3 The outdoor air and exhaust air dampers of ERV units shall be in the fully open position.
  - .4 Upon a request for heating, the energy recovery wheel and the natural gas fired heat exchanger shall modulate to maintain the discharge air temperature setpoint of 18°C.
  - .5 Gas-fired unit heaters shall provide primary heating during occupied hours. These units shall provide stage 1 heating (thermostats set to 18°C) and the ERV is stage 2 heating (thermostats set to 15°C).

.4 During High COx-NOx levels:
- .1 Below operation is regardless of Unoccupied or Occupied hours or ERV units enabled or disabled.
  - .1 If any of COxNOx sensor gets triggered within the respective zone, the wall louvers shall be opened in that zone.
  - .2 After the damper opening time has passed, the respective roof fans shall be enabled. The exhaust fans of the respective zone's ERV units shall also be enabled regardless of their operation at the time. If the ERVs are already operating, the supply fans of the ERV units shall be disabled, return fans shall be stayed enabled.
  - .3 Once the COxNOx level is reached to the low threshold value (maximum allowable limit in the zone), and minus the offset value, the roof fans shall be disabled, ERV units shall be returned to their normal operation. Then wall louvers shall be closed.

.5 Status:
- .1 Display ON/OFF

.6 Alarms:
- .1 Fan off when commanded on.

.2 Fan on when commanded off.
.3 Filters require replacement.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 Comply with the Mechanical General Requirements of Section 20 01 00 and the Common Mechanical Work Results of Section 20 05 00.

.2 Read and conform to:
- .1 The Contract CCDC 2, Stipulated Price Contract as amended in the Contract Documents;
- .2 Division 01 requirements and documents referred to therein.

1.2 REFERENCES

.1 ANSI/ARI 210/240, Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
.2 ANSI Z83.8/CSA 2.6, Gas Unit Heaters and Gas-Fired Duct Furnaces.
.3 ANSI/AWS D1.2/D1.2M, Structural Welding Code - Aluminum.
.4 ANSI/NFPA 90A, Installation of Air-Conditioning and Ventilating Systems.
.5 ANSI/UL 465, Central Cooling Air Conditioners.
.6 ARI 270, Standard for Sound Rating of Outdoor Unitary Equipment.
.7 ARI, Air Conditioning and Refrigeration Institute.
.8 CSA 2.6 (ANSI Z83.8), Gas Unit Heaters and Gas-Fired Duct Furnaces.
.9 CSA B52, Mechanical Refrigeration Code.
.10 CSA B149.1, Natural and Propane Gas Installation Code.
.11 CSA C22.1, Canadian Electrical Code, Part 1.
.12 CSA W59, Welded Steel Construction (Metal Arc Welding).
.13 C-E.T.L., Testing Laboratories.
.14 CGA, Canadian Gas Association.
.15 C.I.R.I., Canadian Industrial Risks Insurers.
.16 CSA, Canadian Standards Association.
.17 ULC, Underwriters Laboratory of Canada.

1.3 DESIGN/PERFORMANCE REQUIREMENTS

.1 Performance and operation third-party certified by ETL to meet and/or exceed all requirements of CSA 2.6 (ANSI Z83.8).

.2 Refer to Drawing schedules for performance and related requirements.

.3 No more than 5% variance from the scheduled values for all indicated operating points including full and partial speeds.

.4 Heat exchanger/burner thermal performance: 80% or better.

.5 Units provided with variable air volume shall have burners limited to a minimum of 20% of full fire (5:1 turn down) when unit is operating at lowest air flow operating point.

.6 Heat exchangers shall be designed to manage condensate produced at any possible operating condition, without damage due to corrosion, scaling, etc.

.7 Where required, units designed to be knocked down for indoor installation.

.8 Sound pressure: Sound at roof emitted through casing or intakes not to exceed levels indicated below, at indicated distance from unit and high airflow rates:
.1 All units: 78.4 dBA at 1.0 m (LWA=85.7).

.9 Sound pressure to interior spaces: Sound emitted from supply and return openings not to exceed levels indicated below, at indicated distance from unit and high airflow rates:
.1 All units: 82.0 dBA at 1.5 m (LWA = 93.0).

.10 Unit installed weight not to exceed weight indicated on the Drawing schedules.

.11 Gas train designed and sized (and unit labelled) for full firing capacity and stable operation across the entire turn-down ratio for the following range of gas inlet pressures:
.1 Minimum: 1.7 kPa (7" WC).
.2 Maximum: 3.5 kPa (14" WC).

.12 Unit controls designed to achieve interlocks and sequence of operation indicated. Consideration shall be given to all potential modes that the equipment may be operated in; no codes shall be contravened under any condition that the controls may be set to.

.13 Motors greater than 5 HP shall be mounted at the bottom base of the unit and lined up with access doors to provide straight-out motor removal and replacement.

.14 All sections of the unit where debris, snow, etc. may collect shall be accessible for cleaning.

.15 All unit sections shall have a drain, including control cabinets.

.16 Filter sections shall be arranged to utilize standard Manufacturer's sizes of filters. Frames shall include allowances for variations in dimensions between filter Manufacturers.

.17 Heat section shall have the basic heating performance at Ajax design day heating conditions and associated dry room conditions as indicated unit schedule.

.18 Shop Drawing(s):
.1 Submit in accordance with Section 01 33 00 indicating:
.1 Performance criteria, compliance with appropriate reference standards, characteristics, limitations, and troubleshooting protocol.
.2 Standard components used in the assembly of the equipment including but not limited to:
.1 Burner.
.2 Fan.
.3 Fan motor.
.4 Flame safeguard control.
.5 Temperature switches and transmitters.
.6 Pressure switches and transmitters.
.7 Damper actuators.
.8 Motor contactors and overloads.
.9 PLC and/or smart relays.

.10 Control panel lights and switches.
.11 Disconnect switches.
.12 Flexible duct connectors.

.3 Equipment, piping, and connections, together with control assemblies, thermostatic controls, auxiliaries and hardware, and specified ancillaries which are mounted, wired and piped ready for final connection to ductwork and start-up.

.4 Accessories shipped loose by packaged equipment Supplier, showing their final location in field assembly.

.5 Control equipment shipped loose, by packaged equipment Supplier, showing final location in field assembly.

.6 Unit dimensions shall match structural supports and duct inlet, outlet. Include recommended method of installation, sizes and location of mounting bolt holes; lifting lugs, include mass distribution drawings showing point loads and total unit weight.

.7 Submit Manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring, field wiring, sequences of operation and all control devices.

.8 Submit performance curves for fans.

.9 Details of vibration isolation.

.10 Estimate of sound power levels expected across each individual octave band on dB referred to A rating.

.11 Type of refrigerant used.

.19 Quality Assurance Submittal(s):

.1 Submit certificate of completion of fabrication prior to shipment, including certified weights of each unit weighed after fabrication has been completed.

.20 Commissioning Submittal(s):

.1 In accordance with Section 01 78 00:

.1 Submit Test Procedures.
.2 Submit Certificate of Readiness.
.3 Submit Test Reports.
.4 Submit Closeout Report.

.21 Closeout Submittal(s):

.1 Submit the following for incorporation into Operation and Maintenance Manuals in accordance with Section 01 78 00:

.1 Submit brief description of systems and include same at beginning of manual, properly indexed, with details of function, operation, control, and service for each piece of apparatus.

.2 Identification: Manufacturing name, type, year, serial number, number of units, capacity, and identification of related systems.

.3 Maintenance and troubleshooting guidelines/protocol, and recommended equipment for analysis and repair. Manufacturer's instructions govern installation and unless otherwise noted, operation, maintenance and service of items.

.4 Manufacturer’s installation instructions for each type of unit including:

.1 Craning and lifting.

.2 Support frame installation.
.3 Connection of services.
.5 Manufacturer's delivery and storage instructions for each type of unit including:
.1 Protection from the weather.
.2 Off-loading and handling.
.3 Protection from damage.
.6 Lubrication schedule indicating lubrication points and type of lubricant recommended.
.7 Consumables.
.8 Safety precautions.
.9 Warranty information.

1.4 QUALITY ASSURANCE

.1 Co-ordinate requirements for:
.1 Roof curb.
.2 Roof and wall openings.
.3 Electrical power.
.4 Control interface.
.5 Gas piping.
.6 Identification.
.7 Fire alarm system interface.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver equipment only when ready for installation. Co-ordinate delivery with construction of curbs and roof openings.

.2 Transport, hoist and handle equipment in accordance with Manufacturer's instructions.

.3 Reject damaged equipment.

.4 Protect roof openings until equipment is installed.

1.6 INDIRECT-FIRED MAKE-UP AIR AND HEATING UNITS

.1 General:
.1 ETL certified and fabricated in accordance with the most recent applicable CSA and ANSI standards.
.2 Natural gas indirect fired make-up air and heating units: Packaged systems, complete with filters, fan, burners, venting, prewired controls, weathertight and/or gasketted casing and other appurtenances, fire tested.
.3 Indirect fired make-up air heating units: See schedule (MUA-1).
.4 Unit: Conform to CSA B203.7, CSA B149.1 and Ontario Regulation 826/82.
.5 Burners and burner controls: CGA and C-ETL approved.
.6 Refer also to Section 20 05 00.
.7 Unit: CGA approved factory assembled, wired and tested.
.8 Unit arranged for side-mounted duct connections (not through the curb).

.2 Casing:

.1 General:

.1 Fabricate unit casing of heavy gauge industrial equipment, double wall construction, satin coat galvanized sheet steel.

.2 Make unit construction for removal of major components without cutting.

.3 Make units which are shipped or installed in sections due to size, factory wired and piped either to numbered terminals in junction boxes, or coded bulkhead fittings as applicable requiring only final connections to be made in the field for a complete integral unit housing all components. Assemble sections of units using gaskets and fastenings supplied with unit.

.4 Weatherproof unit casing: Fabricate unit with cross-broken sloped roof panels to prevent water accumulation.

.5 All walls, roof and floor of formed construction, with minimum two breaks at each joint.

.6 Wall and floor joints broken inward; roof joints broken outward for rigidity.

.7 All joints caulked with waterproof sealant.

.8 Make-up units: Side by side arrangement of exhaust and intake sections. Stacked arrangement not permitted.

.9 Outdoor unit: Base frame designed for mounting on parallel roof sleeper curbs, with bottom of unit thermally insulated.

.10 Outer skin: 1.3mm (18 ga).

.11 Inner skin: 1.0mm (22 ga).

.12 Floor construction: 1.6mm (16 ga) checker plate.

.13 Frame: Structural steel base frame. Full perimeter C-channel with under floor reinforcing channels to minimize deflection.

.2 Intake Section:

.1 Outdoor make-up air (MUA) units to have horizontal type intake air hood or intake plenum section both of stormproof louvre construction with galvanized wire birdscreen. Refer to Contract Drawings for either hood or plenum arrangement for each unit.

.2 Make the inner skin around fan section and intake section perforated.

.3 Unless indicated otherwise, provide unit intake plenum with side louvres where shown on Drawings to limit (directional) sound to the surrounding area.

.4 Provide unit with louvre intake hood only where shown on Drawings.

.5 Louvres: Stormproof, drainable, high efficiency, low pressure drop, high free area and selected at 2.5 m/s.

.6 Unit mounted drain pan and 50mm drain to roof.

.7 Designed to prevent entry of rain or snow.

.3 Access Doors:

.1 Make access doors of sufficient size and number to allow physical entry for servicing of filters, fans and motors, from both sides of the unit. Provide each door with two lever lock roller handles operable from both inside and outside.

.2 Hinge access doors with stainless steel lift-off type hinges with galvanized sliding door stops (hold-backs). Seal door frames with 'E'-profile gasket to eliminate water infiltration by capillary action.
.3 Fabricate access doors of rigid industrial type of heavy gauge steel, double wall construction and insulated.
.4 Provide twin access doors with removable mullion where required for full access for removal of fans and motors.
.5 At least one access door centered with the axis of the fan motor to facilitate straight-out removal of the motor.
.6 All doors and entry points labelled "Qualified Personnel Only".
.7 All entry points to 120 volt or higher voltages shall be labelled with suitable warnings.
.8 Each access door with access to moving parts, open flames or other hazards shall be fitted with an interlock switch which shall immediately shut down operation when the door is opened more than 50mm. Interlock switches shall be protected from inadvertent activation.
.9 All access doors shall have hold-back ties. Stoppers shall not be provided.

.4 Insulation:
.1 Insulate unit with 50mm minimum insulation (entire unit including floor) secured with fire retardant adhesive and welded pins.
.2 Minimum density 48kg/m³.

.5 Painting:
.1 Clean exterior surfaces of air handling equipment at factory with approved degreasing agent.
.2 Clean phosphatized galvanized metal, prime and topcoat units with exterior grade primer and grey enamel.
.3 Apply paints electro-statically, or air-sprayed and baked.

.6 Design units to be lifted by helicopter, crane, forklift or other lifting equipment. Provide suitable lifting lugs and identify lifting points for installation methods.

.7 Guarding:
.1 In accordance with Section 20 05 00 and as noted below.
.2 Discharge Openings: Steel grating, paint yellow.
.3 Belt Drive Guards: Shall not be required; adequate safety interlocks shall be provided. See Access Doors above.
.4 Electrified points of contact: There shall be no exposed and electrified terminals, contacts or other surfaces at 120 volt or higher anywhere in the unit which can be reached without tools. Exposed electrified surfaces shall be covered or otherwise guarded from contact.

.3 Heating Section:
.1 General:
.1 Application: Industrial grade heating, inputs 150 kW (511 MBH) or more.
.2 Heating Section, including all controls, CGA or ETL approved, and submit proof of approval.

.3 Heater shall consist of a positive pressure heat exchanger, with primary drum and multiple tube secondary assembly. Heat exchanger constructed of titanium stainless steel with multi plane turbulators and of a floating stress-relieved design.
.4 Perform welding as recommended in welding handbook published by American Welding Society most recent edition.
.5 The metal temperature, when fired at guaranteed rating, shall not exceed 75% of scaling temperature of metal.
.6 The heat exchanger shall have a permanent observation port to allow observation of pilot and main flame. Observation port for heat exchanger of sight glass type mounted on back of heat exchanger.
.7 Condensate drain at flue side.

.2 Primary Heat Exchanger:
.1 The primary combustion chamber shall be arranged in the heater casing in such a manner as to allow air to pass over it properly for heat transfer, but without excessive static loss.
.2 The chamber shall be constructed to allow total expansion.
.3 All welded 304L stainless steel construction and shall have no refractory welding. Minimum 1.5mm (16 gauge).

.3 Secondary Heat Exchanger:
.1 The secondary heat exchanger shall be seamless 304L stainless steel tubes. Minimum 1.5mm (16 gauge).
.2 Mount to allow total expansion.

.4 Burner:
.1 The burner shall be a blow through positive pressure type with intermittent pilot ignition system.
.2 Burner shall be full modulation, minimum 15:1 turndown ratio. Except: Where variable air volume is specified, use turn-down ratio indicated elsewhere.
.3 Burner to include combustion air blower with non-sparking paddle wheel type impeller, pilot, spark igniter, stainless steel discharge sleeve, mixing cone, self-contained internal air and gas proportion valves, and safeguard sensor.
.4 Air and fuel to be linearly mixed throughout the firing range for optimum efficiency at all inputs.
.5 Capacity regulation through the entire range of the burner shall control the following functions:
.1 Controlled shut down position.
.2 Ignition gas position.
.3 Low fire gas position.
.4 High fire gas position.
.6 The flame safeguard burner control shall be self-annunciating which allows for immediate identification of cause of shut-down in conjunction with the operating instructions. The flame and its stability are monitored by a flame rod of UV sensor. Control shall include digital outputs compatible with BACS for monitoring of burner status.
.7 The modulating controller shall be stable PI electronic temperature controller complete with self-diagnostic lights on face of controller,

readout pins for supply air temperature and set point, and lock-out reset button. All control mode adjustments shall be easily accessible and adjustable during controller operation.

.8 Burner shall have a permanent observation port to allow observation, visual inspection of pilot and main flame.

.5 Gas Valve Train:

.1 Burner gas valve train to include, but not limited to: Main and pilot pressure regulators, motorized main gas valve, main and pilot firing valves, automatic pilot solenoid valve, and test openings as required. Valve train to be CGA approved.

.2 Main gas automatic safety shut-off valve with auto reset.

.3 Low gas pressure switch, adjustable set point, manual reset.

.4 High gas pressure switch, adjustable set point, manual reset.

.6 Gas Flue Venting:

.1 Provided by unit manufacturer in accordance with CGA and CSA requirements.

.2 Double wall stainless steel.

.4 Fan Section:

.1 General:

.1 Fan AMCA rated, and statically and dynamically balanced. Fan constructed in strict conformity with the standards of AMCA and rated in full conformity with the "Standard Test Code of Centrifugal and Axial Fans", approved jointly by ASHRAE and AMCA.

.2 Fan section of nominal size so design air flow at mid-range of capacity of fan.

.3 Spring vibration isolation selected for 25mm deflection.

.4 Statically and dynamically balanced to 2mm/s peak or less.

.2 Casing:

.1 Heavy gauge steel casing with continuously welded construction.

.2 Discharge flanges for duct connections.

.3 Heavy duty, high-temperature, flexible duct connector, in accordance with Section 23 33 00. Flexible duct connector accessible for replacement without requiring fan removal.

.4 Finish: Degreased, de-burred, sandblasted, rust preventative primer, and epoxy topcoat suitable for outdoor exposure.

.3 Fan Wheel:

.1 Welded steel construction for industrial application.

.2 Backward inclined airfoil blades, single thickness plate type, solid welded to rim and back plate.

.4 Shaft:

.1 AISI 1040 or 1045 hot-rolled steel, accurately turned, ground, polished and ring gauged for accuracy.

.2 First critical speed greater than 200% of maximum fan speed.

.3 Shaft coated with petroleum based rust protector.

.4 Provide single motor and drive arrangement with coupling-connected common shaft where two fan wheels required.

.5 Bearings:

.1 Heavy duty, split pillow-block grease lubricated ball or roller self-aligning type.

.2 Oil retaining, dust excluding seals.
.3 Stainless steel bearing lubrication lines extended to cabinet exterior.
.4 Certified minimum rated life of 80,000 hours to (Anti-Friction Bearing Manufacturer's Association) AFBMA L-10 life standard.

.6 Drive (variable air volume):
.1 Direct drive fan and motor arrangement in accordance with Section 20 05 00.
.2 Arranged with motor mounted on unit floor.
.3 Variable Frequency Drive (AFD) with dv/dt filters and reactors.
.4 Speed range set to achieve scheduled range of operation.
.5 Range of operation coordinated to limit burner turn down to 5:1 (20% full fire) when operating at lowest speed.

.7 Motor:
.1 Rated for fan duty, TEFC, T-frame, high-efficiency in accordance with Section 20 05 00.
.2 Voltage indicated on Drawing schedules.
.3 Where indicated provide VFD rated motors.
.4 Gas tight fire rated flexible connection to allow free movement of fan during operation.

.5 Filters:
.1 Replaceable, disposable 50mm deep.
.2 Filters shall be common size; mounting frames shall accommodate variances in sizes between various Manufacturers.
.3 Size for 2.3m/s (450 FPM) or less filter velocity.
.4 MERV 8 filtration efficiency (formerly 30%).
.5 Mount in V-bank configuration, and secure with galvanized wire mesh downstream of filter to prevent filters being drawn into the fan/burner section.
.6 Filter section to have 50mm drain.

.6 Intake Air Damper (MUA's):
.1 Fabricate damper with heavy duty parallel or opposed blades, designed to withstand static pressure specified, nylon bushings, edge and end seals, and thrust washers.
.2 Engineered for minimal leakage in accordance with AMCA Standard 500.
.3 Blades 150mm wide, aluminum extrusion and internal hollows insulated with polyurethane foam and thermally broken, minimum R=2.2.
.4 Frames minimum 2.0mm thick extruded aluminum insulated with polystyrene.
.5 Double-Sealed bearings, where Celcon inner bearing fixed on hexagon rod rotates within polycarbonate outer bearing inserted in frame.
.6 Blade linkage out of air stream in frame. Fabricate steel hardware cadmium plated.
.7 Belimo type spring return actuator with end switch and sufficient torque and speed to open damper suitable to the design of the system.
.8 End switches to indicate both fully open and fully closed positions of the damper.

.7 Controls:

.1 General:

.1 Description of control hardware for typical unit. Adjust to suit each type of unit as described below.

.2 Electronic controller complete with self-diagnostic indicating lights, operating and fault codes.

.3 High ambient temperature limit switch, manually adjustable, set @ 58°C shall shut down unit and restart automatically when alarm is cleared.

.4 High temperature limit switch (Firestat), manually adjustable, set @ 82°C shall shut down unit, and restart automatically when alarm is cleared.

.5 Low ambient temperature limit switch (freezestat), manually adjustable, set @ 16°C shall shut down unit, and restart automatically when alarm is cleared.

.6 Flame safeguard relay with alarm contacts and equipped with a compatible digital output for monitoring by the BACS.

.7 Filter differential pressure transmitter (4-20 mA), field calibrated.

.8 Spark ignition.

.9 Pilot time delay (30 sec.) relay switch.

.10 Pilot automatic valve.

.11 Fan time delay relay switch.

.1 Fan control circuit has 0 – 10 minute adjustable timer to run the fan after burner shutdown to purge heat from the heat exchanger.

.12 Ignition transformer.

.13 Supply air temperature controller.

.14 Supply fan air proving differential switches, field calibrated.

.1 High velocity.

.2 Low velocity.

.15 Low fire holding relay.

.16 Unit mounted weatherproof disconnect switch.

.1 NEMA 4X, stainless steel.

.2 Fused.

.3 Lockable.

.4 Mount beside control panel, factory wired.

.17 Exhaust fan interlocks: Hard-wired interlocks with exhaust fan starters at MCC's for simultaneous operation (single and 2-speed) as indicated on the Drawings.

.18 Interlock type: all interlocks between exhaust and supply sections shall be made utilizing air flow proving pressure switches hard-wired to the proving contacts of the unit. Separate contacts and proving switches shall be provided for each speed of operation.

.19 Smoke detector contact for unit shut down.

.20 Control circuit fuses and transformer.

.21 Fire alarm shutdown contact for connection to building fire alarm system with operation as follows but not limited to:

.22 In case, fire is outside the 2nd floor, start MUA-1, shut down KEF-1 (regardless of their status at the time if the event)

.23 In case, fire is inside the kitchen or 2nd floor , shut down MUA-1, start KEF-1 (regardless of their status at the time of the event)

.24 Wherever fire happens shut off “Gas Shut-off Valve” in the Kitchen, regardless of the fire location.

.2 Unit Control Panel:

.1 Provide integral control panel complete with hinged access door and have galvanized sliding door stops with latching handles. All contents labelled and wired to a numbered terminal strip. Wiring shall be colour-coded and number-tagged at each end to match the control diagram supplied. Control panels shall include control transformer, fan motor starters complete with overload and over-current protection to motor HP rating, control circuit fuses and all controls required for automatic reset operation with any of the optional accessories selected.

.2 A factory wired 120 Volt single phase power service outlet shall be provided at the unit control panel. Provide a separate NEMA 4X disconnect (and transformer, as required) to the service outlet to maintain power with unit disconnect off.

.3 Refer to Contract Drawings and Sections for interlocking of associated equipment and sequences of operations. Indications for high speed, low speed and quantities of exhaust fan H-O-A switches, interlocking and status indications are as applicable.

.4 Unit panel to house controls including but not limited to the following:

.1 HAND/OFF/AUTO.
.2 High Speed, Low Speed, Stop.
.3 Summer/Winter (Enable/Disable Burner).
.4 Discharge Air Temperature Control.
.5 Exhaust fan “Hand-Off-Auto” switch.

.5 Unit panel to have 32mm pilot light indicators for (but not limited to):

.1 High Speed and Low Speed.
.2 BACS Call: High Speed and Low Speed.
.3 BACS Call: Heat Disable.
.4 Exhaust Fan Fault.
.5 Exhaust Fan ON.
.6 Exhaust Fan OFF.

.6 On resumption of any power failure, high voltage relay on main power supply to activate a 0-60 minute adjustable timer in series with unit controls to provide automatic start-up.

.7 Control panel shall be heated and sufficiently ventilated to control condensation and shall include an opening at the bottom to drain away moisture.

.8 Sufficient temperature-controlled space provided to accommodate BACS control modules. Coordinate and provide power to BACS from main equipment power supply.

.9 BACS control modules must be field installed. Units provided with pre-installed BACS modules shall not be permitted.

.10 Electrified points of contact: there shall be no exposed and electrified terminals, contacts or other surfaces at 120 volt or

higher anywhere in the control cabinet which can be reached without tools.

.3 SEQUENCE OF OPERATION WITH EXHAUST FAN:

.1 MUA-1 and KEF-1 H-O-A:

.1 AUTO:

.1 Unit initiates to run on call from BACS. Reverse interlocking control strategy.

.2 Inlet damper opens.

.3 Unit calls exhaust fan to start.

.4 Once exhaust fan confirmed running, unit starts fan and burner.

.5 Exhaust fan fault: Unit stops.

.6 Burner fault: Fan starts and continues to run until freeze stat trips.

.7 MUA fault (no ventilation): Exhaust fan to shut down.

.8 Temperature set point: As scheduled from BACS.

.9 Burner enable/disable: As scheduled from BACS.

.2 OFF:

.1 All functions disabled.

.2 EF permitted to run if selected to hand.

.3 HAND:

.1 Unit initiates to run from pushbutton on control panel.

.2 Inlet damper opens.

.3 Unit calls exhaust fan to start.

.4 Unit starts fan and burner.

.5 Exhaust fan fault: Unit continues to run.

.6 Burner fault: Fan starts and continues to run until freeze stat trips.

.7 MUA fault (no ventilation): Exhaust fan to shut down.

.8 Temperature set point: As selected from dial on control panel.

.9 Burner enable/disable: As selected from switch on control panel.

.2 Exhaust Fan KEF-1:

.1 **AUTO:** Exhaust fan runs as called by MUA-1.

.2 **OFF:** Exhaust fan cannot run, regardless of MUA settings.

.3 **HAND:** Exhaust fan runs regardless of MUA settings.

.3 PANEL INPUTS AND OUTPUTS:

.1 General:

.1 Numbered terminal strips provided for wiring of all inputs and outputs.

.2 BACS inputs and outputs organized and separated from hard-wired points.

.2 Hard-wired analog inputs:

.1 EF running (interlock).

.2 Fire alarm shut down.

.3 Smoke alarm shut down.

.3 Hard-wired analog outputs:
  .1 EF call to run.
.4 BACS inputs:
  .1 Run MUA.
  .2 Heating enable/disable.
  .3 Supply air temperature set point.
.5 BACS outputs (unit status points):
  .1 MUA fan H-O-A position.
  .2 MUA fan running.
  .3 MUA fan fault.
  .4 Damper open.
  .5 Damper closed.
  .6 Filter pressure differential (4-20 mA).
  .7 EF H-O-A position.
  .8 EF running.
  .9 EF fault.
  .10 Burner ON.
  .11 Burner status (% fire).
  .12 Burner trouble codes.
  .13 Heating mode (enabled/disabled).
  .14 Low gas pressure.
  .15 High gas pressure.
  .16 Air proof switch.
  .17 Flame fail.
  .18 Burner fault.
  .19 Heating alarm.
  .20 Heating fault.
  .21 Supply air temperature.
  .22 Low temperature fault.
  .23 High temperature fault.
  .24 Firestat.
  .25 Exhaust side temperatures, downstream of hood.
  .26 Supply side temperature, downstream of MUA-1.

1.7 IDENTIFICATION

.1 Refer to the requirements of Section 20 05 53 for the following:
  .1 Equipment Nameplate.
  .2 Manufacturer's Nameplate.
  .3 Motor Nameplate.

1.8 ROOF CURBS

.1 Site fabricated structural roof curb in accordance with Contract Drawing details and to requirements of National Roofing Contractors Association (NRCA), minimum height 350mm above finished roof level.

.2 Manufacturer's pre-fabricated roof curbs not permitted.

1.9 EXAMINATION

.1 Prior to delivery examine each unit location on-site to confirm adequate provisions for curb/support steel. Advise the general trade and TTC prior to delivery where provisions are not adequately provided, or unit dimensions differ from those on-site.

1.10 PREPARATION

.1 Co-ordinate duct sizes, gas service requirements, unit arrangements and weights venting and power requirements with associated trades.

.2 Provide reviewed Shop Drawings of each unit type indicating required dimensions of roof curbs to trades responsible for constructing roof curbs.

.3 Confirm Shop Drawings of roof curbs acceptable for respective units.

1.11 GENERAL

.1 Install per Manufacturer's recommendations, reviewed Shop Drawings, as indicated on Contract Drawings and as required by applicable codes.

.2 Provide one spare clean set of filters for each unit at Contract closeout.

1.12 HOISTING AND LIFTING

.1 Supply hoisting and lifting equipment and personnel trained in the proper use of hoisting equipment for lifting equipment into place. During hoisting ensure that all unnecessary personnel are well clear of areas where hoisting is to take place. Rope off area as required.

1.13 INSTALLATION

.1 Provide necessary ancillary items including control wiring and devices, hangers, supports, venting, condensate traps and drain piping, and similar items. Any requirements for gas train component venting shall be provided safely to the atmosphere. Indicate pressure relief settings and vent arrangement on As-Built Drawings where PRVs or gas train component venting is required.

.2 For indoor units coordinate heat exchanger and gas venting requirements through the building envelop.

.3 Extend and trap filter, intake and cooling section drains using 50mm galvanized steel piping to roof away from unit or to nearest drain fixture.

.4 Extend heat exchanger drains using rigid CPVC piping away from unit to roof or to nearest drain fixture.

.5 Install discharge air temperature sensor in the duct 2m downstream of the heat exchanger and in accordance with Manufacturer’s instructions.

.6 Locate firestat so as not to be influenced by normal operation of the unit and to protect the heat exchanger from overheating. Examine and prove the function of firestat and relocate if necessary for proper functionality.

.7 Field calibrated all differential pressure switches, airflow proving switches and adjust controls prior to commissioning.

.8 Co-ordinate electrical power requirements with Division 26. All control wiring to be in accordance with Division 26 Specifications.

.9 Ensure heat recovery type units are installed dead level for proper function of the heat recovery Section.

1.14 STRUCTURAL SUPPORTS

.1 Co-ordinate structural steel support requirements as shown on structural Drawings. Provide accurate dimensional and weight data for structural supports in accordance with requirements of Structural Division of the Specifications.

.2 Provide necessary coordination and checking of unit supports to ensure supports are fabricated dead level.

1.15 FIELD QUALITY CONTROL

.1 Have manufacturer review complete installation and provide start-up assistance. Submit letter from manufacturer to TTC upon job completion verifying that installation is complete and operating to manufacturer's approval.

1.16 COMMISSIONING

.1 Perform Commissioning in accordance with 20 05 00.

.2 Verify operational performance in general conformance with the following outline:
- .1 Operational Performance Outline:
  - .1 Unit safeties.
  - .2 Unit operation in Auto mode – all features of unit.
  - .3 Unit operation in Hand mode – all features of unit.
  - .4 Alarms and faults.
- .2 Functional Performance Outline:
  - .1 Interlocking with exhaust fans.
  - .2 Control inputs from BACS.
  - .3 Points monitored by BACS.

1.17 CLEANING AND PROTECTION

.1 Protect from damage from the following:
- .1 Weather.
- .2 Construction.
- .3 Handling.
- .4 Improper use.

.2 Clean dust and debris, touch-up paint/finishes.

1.18 SCHEDULE

.1 Co-ordinate submittals and delivery of equipment with General and Mechanical trades and Contract Milestones. Refer to Section 01 11 00.

1.19 MAINTENANCE

.1 Maintain all equipment and systems installed until Substantial Performance.

.2 Carry out regular scheduled maintenance of equipment and systems following Substantial Performance until Contract Completion.

1.20 CONTROLS LOCATION AND ADJUSTMENTS

.1 Locate control devices for stable and reliable operation, for minimal false alarms and nuisance trips.

.2 For duration of warranty period, relocate control devices that become affected by false alarms, in accurate readings and nuisance trips.

.3 Devices shall include but not be limited to:

- .1 High temperature limit switch.
- .2 Firestat.
- .3 Low temperature limit switch.
- .4 Low gas pressure switch.
- .5 High gas pressure switch.
- .6 Flame rods, sensors and amplifiers.
- .7 Temperature sensors.
- .8 Flow switches.
- .9 Damper end switches.

END OF SECTION

1 General

1.1 ACCESS PANELS AND DOORS

.1 Provide all access panels and/or doors to facilitate the maintenance and/or servicing of all electrical equipment installed in concealed spaces.

.2 Indicate on the "as-built" drawings the location of these panels and doors.

.3 Doors and panels in fire rated enclosures shall be ULC listed sandwich doors and shall have the same rating as the enclosure.

.4 Doors shall have concealed hinges and screwdriver operated lock. Doors shall be as follows:

.1 Concrete Block and Drywall: 12 gauge prime painted steel door.

.2 Plaster and Acoustic Tile: recessed dish shaped door to accept ceiling tile or welded metal lath for plaster.

.5 All access doors and locations shall be to the Consultant's approval.

1.2 CARE, OPERATION AND START-UP

.1 Instruct Consultant and operating personnel in the operation, care and maintenance of equipment.

.2 Arrange and pay for services of Manufacturer's factory service Engineer to supervise start-up of installation, and to check, adjust, balance and calibrate components.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant with all aspects of equipment care and operation.

1.3 CODES AND STANDARDS

.1 Perform the complete installation in accordance with latest editions of the National Building Code, Canadian Electrical Code (C.E.C.), CSA and all other applicable codes, as required.

.2 Comply with C.E.C. Electrical Bulletins in force as of the date of tender closing. While not identified and specified by number in this Division, these bulletins shall be considered as forming part of related C.E.C. Part II Standards.

.3 Abbreviations for electrical terms: in accordance with CSA Z85-1983.

1.4 COMPLETION

.1 Clean all fixtures and equipment. Polish all plated surfaces.

.2 Set all relays to operating condition.

.3 Remove all temporary protection and covers.

.4 Vacuum clean the inside of switchgear, panelboards, motor control centre, and fire alarm control panel and annunciators. Ensure that they are free from debris and dust.

.5 Change all lamps, all lamps to be new at time of system acceptance.

.6 Leave electrical work in as-new working order.

1.5 CONCRETE

.1 Refer to the requirements of Division 03 for all concrete and form work for bases, curbs, and duct banks required for the work of this Division.

1.6 CONDUITS AND CABLE INSTALLATION

.1 Install conduits and sleeves prior to pouring of concrete. Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50mm (2”).

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

1.7 CONSTRUCTION DRAWINGS

.1 Prepare fully dimensioned Drawings showing sleeves and openings through structure. Indicate locations and weights on all load points.

.2 Prepare Drawings of pits, curbs, sills, equipment bases, anchors, inertia slabs, etc.

.3 Prepare fully dimensioned construction Drawings of Products and services in electrical rooms, service and ceiling spaces, and all other critical locations. Co-ordinate the work with the work of all other Divisions. Base Drawings on reviewed shop drawings and indicate all details pertaining to access, clearances, cleanouts, sleeves, electrical connections, drain locations and elevations of pipes, ducts and conduits.

.4 Submit construction/interference Drawings prior to commencement of any site work.

.5 Submit Drawings coordinated and approved by all trades, to the Consultant and include one complete set in each operating and maintenance manual.

.6 Construction Drawings are prepared for construction and record purposes only and are not part of the Contract Documents or shop drawings.

1.8 CONTRACT DOCUMENTS

.1 The Drawings for the electrical work are performance Drawings and diagrammatic, intended to convey the scope of the work and indicate general arrangement and approximate location of apparatus, fixtures and conduit runs. The Drawings do not intend to show architectural and structural details.

.2 Do not scale Drawings. Obtain information involving accurate dimensions shown on architectural and structural Drawings, or by site measurements. Consult general construction Drawings, as well as detail Drawings to become familiar with all conditions affecting work and verify spaces in which the work will be installed.

.3 Make, at no additional cost, any changes or additions to materials and/or equipment necessary to accommodate structural conditions (runs around beams, columns, etc.).

.4 Alter, at no additional cost, the location of materials and/or equipment as directed, provided that the changes are made before installation and any such outlet is not relocated in excess of 3mm (10') in any direction.

.5 Install all ceiling mounted components (luminaires, speakers, bells, etc.) in accordance with reflected ceiling Drawings, approved by the Consultant.

.6 Leave space clear and install all work to accommodate future materials and/or equipment as indicated in the Contract Documents, and to accommodate equipment and/or material supplied by another Division of work or Contract. Verify spaces in which work is to be installed. Install all conduit runs, etc., to maintain headroom and clearances and to conserve space in shafts and ceiling spaces.

.7 Confirm on the Site the exact location of outlets for equipment supplied under other Divisions of work or Contracts.

.8 Confer with all trades installing equipment which may affect the work of this Division and arrange equipment in proper relation to equipment installed under all divisions of the Contract.

.9 Timeously furnish all items to be built in, complete with all pertinent information, commensurate with the progress of the work.

.10 Store materials neatly and out of the way and clean up daily all refuse caused by the work.

.11 Relocate equipment and/or material installed, but not coordinated with the work of other Divisions, as directed by the Consultant at no extra cost.

1.9 EQUIPMENT SUPPORTS, ANCHORS AND HANGERS

.1 Provide all supports required for the erection and support of the electrical work.

.2 Support all suspended equipment from the bottom.

.3 Provide all lintels where required.

.4 Suspend all hangers directly from the structure using approved inserts or beam clamps.

.5 Do not use pipe hooks, or perforated straps.

.6 Hangers shall be spaced such that there is a hanger within 610mm (24") of every bend and that the maximum spacing does not exceed the limits indicated in OHEPC code.

.7 Vertical pipes shall be supported at each floor slab and at the top and bottom of each riser.

.8 Support all conduit or cable at equipment mounted on spring isolators, with spring hangers for at least 4572mm (15').

.9 Do not support any conduits from ductwork, pipes etc.

1.10 EXCAVATION AND BACKFILL

.1 All excavation and backfilling will be carried out in accordance with the requirements of Division 02.

.2 Conform to the performance standards of Division 02.

.3 All rough excavation, i.e., excavation to within 152mm (6") of final elevation, will be performed in accordance with the requirements of Division 02.

.4 All final backfilling, i.e., backfilling from a location 305mm (12") above the electrical equipment or service, to grade, will be performed in accordance with the requirements of Division 02.

.5 Perform all final excavation, i.e., excavation of the last 152mm (6") to final elevation, and all initial backfilling, i.e., backfilling of the first 305mm (12") above the electrical equipment or service.

.6 Conform to the performance standards of Division 02 with respect to all excavation and backfilling.

.7 Obtain approval from the Consultant before backfilling.

.8 After backfilling and compaction, return the surface to match the original condition, or as directed by the Consultant.

1.11 EXPANSION JOINTS AND LOOPS

.1 Supply and install expansion joints or loops in conduits crossing expansion joints in the structure without imposing undue stress on structure, apparatus or conduit.

1.12 EXISTING CONDITIONS

.1 Visit the Site and examine the existing conditions affecting the work of this Division.

.2 No claim for extra payment shall be made for extra work made necessary by circumstances encountered due to conditions which were visible upon, or reasonably inferable from an examination of the site prior to bid submission.

1.13 EXPEDITING

.1 Continuously check and expedite delivery of equipment and materials.

.2 As required, inspect equipment, etc. at the source of manufacture.

.3 Continuously check and expedite the flow of necessary information to and from all parties involved.

.4 Immediately inform the Prime Contractor and the Consultant where information is required from them, and attend to any request for information, details, dimensions, etc. from them.

1.14 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 in order to ensure the installation meet the functionality and performance as per the Contract Drawings.
.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
.5 Systems: fire alarm system, communications.

.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 V with a 500 V instrument.
.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
.3 Check resistance to ground before energizing.

.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 and associated current calibration reports.

.6 Submit test results for Consultant's review prior to energization.

1.15 FIELD REVIEW

.1 The Consultant will make periodic visits to the site during construction to ascertain reasonable conformity to plans and Specifications. The Consultant is not responsible for quality control. Contractor shall maintain its own quality control and will be responsible for the execution of work in conformity with the Contract Documents and the requirements of all applicable authorities having jurisdiction.

.2 The Owner and Consultant shall have access to the site at all times for periodic inspections. Maintain a complete set of contract documents on site for field reference by the Consultant.

.3 Provide all gauges, instruments, and other equipment necessary for field review by the Consultant.

.4 Application for final review will be considered when the Work has been completed and written declarations submitted that all commissioning, adjustment, set up and documentation is complete. Final review shall be done when:
.1 All reported deficiencies have been corrected.
.2 All systems have been tested, commissioned and are operational.
.3 The Owner has been instructed in the operation and maintenance of all equipment.
.4 All reports have been submitted and reviewed.
.5 All instruction manuals have been submitted and reviewed.
.6 All directories and nameplates are in place.
.7 Cleaning up is finished in all respects.
.8 All spare parts and replacement parts specified have been provided.
.9 All record Drawings have been submitted and reviewed.

1.16 FINISHES

.1 Paint metal enclosure surfaces by application of rust resistant primer inside and outside, and a minimum of two coats of finish enamel.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.17 FIRE RATING

.1 All feeder conduits for the following systems shall be 2 hours fire rated in accordance with OBC, Section 3

- .1 Emergency Distribution and Lighting Panels
- .2 Fire Alarm System
- .3 Diesel Oil Pumps
- .4 Emergency Motor Starters and MCC's

1.18 FIRESTOPPING

.1 Where cable, bus ducts, cable tray or conduits pass through floors and fire-rated walls, provide firestopping and smoke seal in accordance with Division 07.

1.19 GENERAL

.1 This Section covers items common to Sections of Division 26. This Section supplements requirements of Division 01.

1.20 GUARANTEE

.1 The Contractor shall furnish a written guarantee, countersigned, stating that all work executed under this Division will be free from defects of materials and workmanship for a period of 1 year from the date of final acceptance of this work. The Contractor shall at its own expense, repair, and replace all such defective work, and all other work damaged during the process of repair during the term of the warranty period, except where damage is due to negligence on the part of the Owner.

.2 Furnish all extended guarantees for equipment requiring same in the Specifications.

.3 Submit such letters for the following:

- .1 Primary Switchboard/Switchgear
- .2 Main Secondary Switchboards/Switchgear
- .3 Emergency Power Supply Generator & Transfer Switches
- .4 Fire Alarm and emergency evacuation equipment System

1.21 HOISTING AND MOVING

.1 Study the architectural and structural Drawings with particular reference to the portions of the structure which are reinforced to withstand the forces applied during the transporting of heavy equipment across that structure.

.2 Devise methods and schedules for the hoisting and transportation of equipment from grade to roof and then into the building, to ensure that no damage occurs to the structure, finish, or any other part of the building. Ensure that the schedule meets with the approval of the Prime Contractor.

1.22 INSERTS, SLEEVES AND ESCUTCHEONS

.1 Supply, locate and set all inserts, anchor bolts and sleeves in time when walls, floors and roof are erected.

.2 Use only factory made threaded or toggle type inserts, properly sized for the load to be carried.

.3 Provide a dimensioned sleeving layout to the Construction Superintendent indicating sizes of sleeves and other structural openings.

.4 Perform all drilling for hangers, rods and inserts, etc., not placed at time of building erection. Do not use powder actuated tools, except on written permission by the Consultant.

.5 Pipe sleeves shall be standard weight steel pipes, machine cut flush with finished structure.

.6 Sleeves in waterproof floors shall extend in 102mm (4”) above the floor (mechanical rooms, kitchens, etc.).

.7 Cover exposed sleeves in finished areas with satin finished chrome or stainless steel escutcheon plates with set screws.

.8 Provide sleeves in below grade wall with waterproofing flange.

.9 In mechanical rooms and on top of shafts the concrete division shall provide 102mm (4”) high (minimum) concrete curbs.

.10 Seal all unused sleeves and openings around conduits and ducts with resilient non-combustible material. In waterproof sleeves provide additional silicon base seal.

.11 Provide and install steel bumper guards around all piping, ductwork, etc., susceptible to being damaged.

.12 All conduits, etc., which pierce quarry tile and/or ceramic tile must be sealed and made watertight.

1.23 INTENT

.1 Provide all items, articles, materials, operations and methods listed, mentioned and scheduled in the Contract Documents. Include all labour, equipment, tools, scaffolds and other incidentals necessary and required for the complete installation.

.2 Consider the specifications as an integral part of the Drawings which accompany them. Do not use the Drawings or the Specifications alone. Consider any item or subject omitted from one, mentioned or reasonably implied in the other, as properly and sufficiently specified and provide same under the work of this Division.

.3 The contractor and all sub-trades are considered to be experts in their fields.

1.24 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% of rated voltage of 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.

1.25 LOCATION OF OUTLETS

.1 Locate outlets in accordance with Division 01.

.2 Do not install outlets back-to-back in wall; allow minimum 6” horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3600mm (12’) from location specified in the Contract Documents, and relocation information is given to the Contractor before installation.

.4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical rooms on latch side of floor.

1.26 MANUFACTURERS AND CSA LABELS

.1 Visible and legible after equipment is installed.

1.27 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Division 01.

.2 Equipment and material shall be certified for use in Canada, i.e., CSA, ULC etc... Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.

.3 Ensure that control panels and component assemblies are assembled at the factory.

1.28 MECHANICAL EQUIPMENT AND WORK

.1 Read the requirements of Divisions 21, 22, and 23 - Mechanical and comply with all requirements. Supply and install all electrical apparatus which is required and is not covered by Divisions 21, 22, and 23 - Mechanical.

.2 Motors:
- .1 Supply and installation of all motors for electrical equipment will be by Division 23.
- .2 All motors will be 60 cycles, 1750 rpm, except where noted otherwise, with the following characteristics:
  - .1 1/3 HP and smaller, 120V, 1 PH, 60 Hz
  - .2 1/2 HP and larger, 575V, 3 PH, 60 Hz
- .3 Division 23 Contractor will submit an accurate schedule of all motors. Include for each motor, the HP, rpm, nameplate current, voltage, phase, equipment served, location, electrical characteristics and identification number. Schedule to be reviewed by the Consultant.

.3 Contactors and Control Devices:
- .1 Supply and installation of all automatic devices controlling mechanical equipment supplied under the Mechanical Division will be performed in accordance with the requirements of Division 23 - Mechanical.
- .2 The Division 26 Contractor shall provide all starters, contactors, MCC's etc., for all equipment required to be supplied under Division 23 such as chillers, boilers, rooftop air conditioning, fans, pumps and heating units, electric reheat coils, etc., as specified in the respective Section in Division 26 – Electrical . Division 23 shall provide disconnect switches for this equipment as required by code. Weatherproof switches shall be provided for all outdoor units.

1.29 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise in the Contract Documents.

.2 If mounting height of equipment is not specified or indicated in the Contract Documents, verify mounting height with the Consultant before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise in the Contract Documents:
- .1 Local switches: 1219mm (48").
- .2 Wall receptacles:
  - .1 General: 305mm (12").
  - .2 Above top of continuous baseboard heater: 152mm (6").
  - .3 Above top of counters or counter splash backs: 152mm (6").
  - .4 In mechanical rooms: 1372mm (4'-6").
- .3 Panelboards: as required by the OESC
- .4 Telephone and interphone outlets: 305mm (12").
- .5 Wall mounted telephone and interphone outlets: 1219mm (48").
- .6 Fire alarm stations: 1194mm (47") and maximum 600mm (23") from door latch.
- .7 Television outlets: As noted on Drawings.
- .8 Wall mounted speakers: 2134mm (7').
- .9 Doorbell pushbuttons: 1219mm (48").

1.30 OPERATION AND MAINTENANCE AUTHORITY HAVING JURISDICTION MANUALS

.1 Submit operation and maintenance manuals in accordance with Division 01.

.2 Include the following information in the Operation and Maintenance manuals:

- .1 Names and address of local suppliers for the items included.
- .2 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of the installation.
- .3 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature is not acceptable.

.3 Review information provided in the maintenance instructions and manuals with the Owners' operating personnel to ensure a complete understanding of the electrical equipment and systems and their operation.

1.31 PERMITS, FEES AND INSPECTION

.1 Submit to local inspection departments as municipal required, and the Power Supply Authority the necessary number of Drawings and Specifications for examination and approval prior to commencement of work.

.2 Pay associated fees.

.3 Consultant will provide Drawings and Specifications required by Electrical Inspection Department and Supply Authority at no cost. Drawings are to be submitted by the Electrical Contractor.

.4 Notify Consultant of changes required by prior to making changes.

.5 Furnish Certificates of Acceptance from AHJ on completion of work to Consultant.

1.32 PLYWOOD

.1 Supply and install all plywood backboards required for the work of this Division. Plywood shall be highest quality fire retardant fir, 1219mm (4'-0") wide x 2438mm (8'-0") high, 19mm (¾") thick unless otherwise specified in the Contract Documents. Prime and paint backboards on both sides with fire retardant paint, equal to CGSB Spec. #1-GP-151M, of a colour to match the equipment and services mounted thereon as defined in "Finishes" above.

1.33 PROGRESS PAYMENTS

.1 Submit a complete breakdown of the Contract with each progress billing, indicating percentage of work complete, in a form acceptable to the Owner/Consultant.

1.34 PROTECTION

.1 Protect building and structure from damage due to carrying out this work.

.2 Protect all electrical work from damage. Keep all equipment dry and clean at all times.

.3 Cover all opening in equipment and materials.

.4 Be responsible for and make good any damage caused directly or indirectly to any walls, floors, ceilings, woodwork, brickwork, finishes, etc.

1.35 RECORD OF DRAWINGS

.1 The Consultant will provide the Contractor with two extra sets of white prints on which the Contractor shall clearly mark, as the job progresses, all changes and deviations from that shown on Contract Drawings. Drawings shall be kept up-to-date during construction and in addition to field measurements shall include variation orders, field instructions and all other changes. After inspection and approval of service lines in trenches, the Contractor shall take as-built measurements, including all depths, prior to backfilling operations. It will not be sufficient to check off-line locations. Definite measurements shall be taken for each service line. The location of buried duct banks, etc. shall be shown on the Drawings from fixed points. On completion of the building, the Contractor shall forward to the Consultant the two sets of Drawings indicating all such changes and deviations for review. Include in the tender price, the cost for the production of CAD diskette record Drawings by the Consultant's staff.

1.36 SHOP DRAWINGS

.1 Refer to the requirements related to shop drawings in Division 01.

.2 As an alternate, the Contractor may submit six copies of standard catalogue sheets where this is normal means of submission for a Supplier.

.3 Shop drawings shall indicate clearly the materials and/or equipment actually being supplied, all details of construction, accurate dimensions, capacity, operating characteristics and performance. Each shop drawing shall give the identifying number of the specific piece of equipment etc. for which it was prepared (e.g., panel #2A).

.4 Each shop drawing for non-catalogue items shall be prepared specifically for this Contract. Shop drawings and brochures for catalogue items shall be marked clearly to show the items being supplied.

.5 Each shop drawing or catalogue sheet shall be stamped and signed by the Contractor to indicate that it has checked the Drawing for conformance with all requirements of Contract Documents including the Contract Drawings,, that it has coordinated equipment included on the shop drawings with other equipment to which it is attached and/or connected thereto and that it has verified all dimensions to ensure the proper installation of equipment within the available space and without interference with the work of other trades. Ensure that mechanical co-ordination is complete before submitting Drawings for review.

.6 Installation of any equipment shall not start until after final review of shop drawings has been completed by the Consultant.

.7 When requested, shop drawings shall be supplemented by data explaining the theory of operation.

1.37 THE REQUIREMENTS OF DIVISION 1 SHALL APPLY EXCEPT AS AMENDED ABOVE.SINGLE LINE ELECTRICAL DIAGRAMS

.1 Provide single line electrical diagrams under plexiglass as follows:

.2 Electrical distribution system: locate in main electrical room.

.3 Electrical power generation and distribution systems: locate in generator enclosure and electrical room.

.4 Provide fire alarm riser diagram, plan and zoning of building under plexiglass at fire alarm control panel and annunciator.

.5 Drawings: 610mm x 610mm (2’ x 2’) minimum size.

1.38 TAGS AND DIRECTORY

.1 After finished painting is completed, identify each main feeder cable and conduit service. Locate identification:
- .1 Behind each access door.
- .2 At each change of direction and at junction boxes.
- .3 At not more than 12 meters (40’) apart in straight runs of exposed conduit, but on both sides of sleeves.
- .4 At not more than 12 meters (40’) apart in straight runs of conduit behind removable enclosures such as lay-in type ceiling, cut on both sides of sleeves.

.2 Use stencils and stencil paint or use lamacoid plates on all conduit and ductwork.

.3 Use letters of minimum 25mm (1”) high.

.4 The identification shall describe system voltage and services; e.g., "120/208 Volt lighting fed from panel 2A".

.5 Conduits and outlet boxes for the various systems shall be identified by the use of distinctive colour paints. The following colours shall be used unless specified in other areas of Contract Drawings:
- .1 120/208 Volt System – Orange
- .2 600 Volt System – Blue
- .3 Telephone Conduit System – Green
- .4 Intercom and Low Voltage Signal Systems – Black
- .5 Emergency System – Yellow

.6 Identify all equipment with lamacoid plastic plates, white background with black engraved letters 6mm (¼”) high, unless otherwise noted in the Contract Documents. Submit an itemized list of all name tag wording to Consultant for approval.

.7 Lighting and Power Panels: Plates to be mounted on door. Typical identification: "Lighting Panel 3A, 347/600 Volt, 3 Phase, 4-Wire". Identify source of power: "Supplied From Main Switchboard AAA".

.8 Disconnect Switches and Starters: Plates to be mounted externally on switch box cover. Typical Identification: "Fan S4, 208 Volt, 3 Phase".

.9 Plates shall be installed after all painting has been completed and shall be secured with mechanical fastening devices, except on the inside of panel doors where gluing will be accepted.

.10 Have the Manufacturers nameplate affixed to each item of all equipment showing the size, name of equipment, serial number and all information usually provided, including voltage, frequency, # of phases, horsepower, etc., and the name of the Manufacturer and his address. Ensure that all stamped, etched and engraved lettering on plates is perfectly legible. Ensure that nameplates are not painted over. Where apparatus is to be concealed, attach the nameplate in an approved location on the equipment support or frame.

.11 Identify all equipment with the corresponding remote controls.

.12 Ensure that panels and other apparatus which have exposed faces in finished areas do not have any visible trademarks or other identifying symbols. Mount nameplates behind doors.

.13 All outlet boxes provided in the ceiling space for future lighting and/or power connections shall be identified on the box cover with Brady self-sticking labels indicating circuits contained in the box.

1.39 TEMPORARY SERVICES

.1 Temporary electrical service for trades shall be the responsibility of the General Contractor unless otherwise noted in the Contract Documents. Do not use any of the permanent electrical systems during construction, unless specific written approval is obtained from the Consultant or unless allowed elsewhere in the Contract Documents.

.2 The use of permanent facilities for temporary construction service must be requested by General Contractor and agreed to by the owner prior to award of tender.

1.40 TRIAL USAGE AND INSTRUCTION TO OWNER

.1 The Owner has the privilege of the trial usage of electrical systems or parts thereof for the purpose of testing and learning the operational procedures.

.2 Carry out the trial usage over a length of time specified in Contract Documents as deemed reasonable by the Consultant at no extra cost.

.3 Carry out the operations only with the express knowledge and under supervision of the General Contractor who shall not waive any responsibility because of the trial usage.

.4 Trial usage shall not be construed as acceptance by the Owner.

.5 Instruct the Owner's representative in all aspects of the operation of systems and equipment.

.6 Arrange for and pay for services of service Engineers and other Manufacturer's representatives required for instruction on specialized portions of the installation.

.7 Submit to the Consultant at the time of final inspection, a complete list of systems stating for each system:

.1 Date instructions were given to the Owner's staff.
.2 Duration of instruction.
.3 Name of persons instructed.
.4 Other parties present (Manufacturer's representative, Consultants, etc.).
.5 Signature of the Owner's representatives stating that they properly understood the system installation, operating and maintenance requirements.

1.41 VALUATION OF CHANGES

.1 Refer to and conform to the requirements set out in Division 01.

.2 Submissions will be scrutinized by the Consultant and therefore require complete detailed itemization of all material, labour, unit prices and overhead and profit mark-ups.

1.42 VIBRATION ISOLATION

.1 Provide vibration isolation control as necessary so as to prevent transmission of objectionable vibration to the building structure, and from one area to another.

.2 Provide all steel bases and concrete inertia pads. Install all bases to clear the sub-base (housekeeping pads) by minimum 25mm (1”) for steel bases, and 50mm (2”) for concrete bases.

.3 All floor mounted equipment shall be erected on 102mm (4”) high reinforced concrete pads. Concrete pads shall be of similar dimensions to that of the footprint of the equipment. Wherever vibrations eliminating devices and/or concrete inertia blocks are specified in the Contract Documents, these items shall, in all cases, be mounted upon the 102mm (4”) high reinforced concrete pads; unless specified to the contrary.

.4 All concrete foundations and supports shall be provided by the Contractor in accordance with the requirements of Division 26. This Contractor shall provide dimensioned drawings and details of all such work required and shall submit same to the Consultant for approval.

1.43 VOLTAGE RATINGS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.44 WARNING SIGNS

.1 As specified and to meet requirements of Electrical Inspection Department, all applicable authorities and the Consultant.

.2 Decal signs, minimum size 175mm x 250mm (8” x 10”).

1.45 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring shall be suitable for either copper or aluminum conductors.

1.46 WORKMANSHIP

.1 Install conduits and pipes parallel and perpendicular to the building planes and concealed in chases, behind furring or above ceiling, except in unfinished areas. Install all exposed systems neatly and grouped together, to present a neat appearance.

.2 Install meters and switches to permit easy reading.

.3 Install all equipment and apparatus requiring maintenance, adjustment or replacement with sufficient clearance for servicing.

.4 Install control devices to guarantee proper sensing. Shield element from direct radiation and avoid placing them behind any obstruction.

.5 Include in the work all requirements of the Manufacturer and as shown on the shop drawings.

.6 Replace any work unsatisfactory to the Consultant/Owner without extra cost.

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

NAMEPLATES

1 General

1.1 REFERENCES AND RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 05 31
.3 Section 26 12 17
.4 Section 26 24 02
.5 Section 26 24 13
.6 Section 26 24 16
.7 Section 26 24 17
.8 Section 26 27 26
.9 Section 26 28 23
.10 Section 26 36 23
.11 Conform to relevant Sections of Specifications for Division 26 and other Divisions.

1.2 MEASUREMENT AND PAYMENT

.1 All costs associated with the work of this Section shall be included in the price for Item No. 3 in the Bid Form.

2 Products

2.1 NAMEPLATES

.1 Nameplates
  .1 Construct all nameplates from laminated plastic having a black core with a white top lamination such that engraving through the top lamination will reveal black lettering on a white background.
  .2 Construct all warning and emergency power nameplates from laminated plastic having a white core with a red top lamination such that engraving through the top lamination will reveal red lettering on a white background.

.2 Sizes
  .1 Provide nameplates of the sizes indicated in the Contract Documents. Where a size is not given in the Contract Documents, provide a standard size nameplate of sufficient size to contain the text indicated in the Contract Documents.
  .2 Where a numerical size is indicated in the Contract Documents, provide a nameplate of a size as indicated in the table below. Provide lettering of the height indicated below unless another size is indicated.

Size	Width (mm)	Height (mm)	First Line lettering height (mm)	Following Lines lettering height (mm)
1	50	25	13	7.5
1A	50	25	7.5	7.5
2	75	50	13	10
3	75	50	10	7.5
4	100	50	25	10
5	125	75	13	10
6	200	100	25	10

.3 Provide lettering of the height indicated in the Contract Documents. Where no height is indicated in the Contract Documents, provide lettering 10mm high for the first line and 7.5mm high for all following lines.

.3 Specific Nameplates

.1 For each power and distribution transformer, provide a Size 5 nameplate to indicate the following information. The number in brackets indicates the lettering height in millimeters:

.1 Line 1: Equipment tag number (13)

.2 Line 2: Rated voltage, kVA, phase and frequency (10)

.3 Line 3: Power source (10)

.4 Example: B90_NPD_DP05_TXF_005
600V/120/208V 3-PH 4-W
Fed From B90_NPD_DP05_DP_005

.2 For each panelboard, disconnect switch, loose starter, etc. provide a Size 3 nameplate to indicate the following information. The number in brackets indicates the lettering height in millimeters:

.3 Line 1: Equipment tag number (10)

.4 Line 2: Rated voltage, phase and wires (7.5)

.5 Line 3: Power Source (7.5). As per Structured product labeling standards, refer to example noted above and electrical single lines for equipment tagging.

.4 Warning Nameplates

.1 Type "A", width = 100mm, height = 100mm (Text height in millimetres in brackets)

.2 Text:

DANGER (25)
MORE THAN ONE POWER SOURCE (10)
CONTAINED WITHIN, (10)
DISCONNECT ALL POWER (10)
SOURCES BEFORE SERVICING (10)
THIS EQUIPMENT (10)

3 Execution

3.1 INSTALLATION

.1 Coordinate final nameplate design, colour and nomenclature with the Consultant prior to ordering of nameplates.

.2 Install nameplates on the front of the equipment on a prominent flat surface. Attach the nameplates with non-rusting screws.

.3 Provide red mimic bus as specified in the Contract Documents.

.4 Provide an Excel spreadsheet with all Nameplates for review by the Owner and the Consultant prior to manufacturing. Submit as a shop drawing.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 12 17
.3 Section 26 24 13
.4 Section 26 24 16
.5 Section 26 24 17
.6 Section 26 28 21
.7 Section 26 28 23
.8 Section 26 36 23
.9 Conform to relevant Sections of the Specifications for Division 26 and other Divisions.

1.2 SUMMARY

.1 The short circuit analysis evaluates the adequacy of the electrical equipment to withstand or to interrupt the calculated maximum available short circuit current at its location.

.2 The overcurrent device time-current coordination analysis determines the suggested settings and, where appropriate, the ampere ratings and types for the electrical power system protective devices to achieve the desired system protection and electrical service continuity goals.

.3 The arc flash analysis calculates arc flash incident energy, flash protection boundary distances and personal protective equipment (PPE) to be used within the flash protection boundary. This analysis is required to meet CSA Z462 and NFPA 70E requirements.

.4 Complete engineering as-built one line diagrams shall be provided using engineering software.

.5 The furnishing and the installation of Arc Flash warning labels shall be provided.

.6 Three bound copies of the required electrical power system studies and engineering software generated one line diagram shall be part of the report.

.7 The company performing the studies shall have at least 10 years of experience performing such studies and the analysis shall be reviewed and sealed by a registered Professional Engineer.

.8 Studies shall be performed using the latest edition of SKM System Analysis Power tools software, unless otherwise noted in the Contract Documents.

.9 Acceptable companies to provide the study related to all aspects of Specification Section 26 05 10 are approved as a basis of design:
.1 Brosz and Associates
.2 Eastenghouse
.3 G.T. Wood
.4 Schneider Electric Ltd.
.5 Eaton Canada

1.3 ELECTRICAL POWER SYSTEM STUDIES

.1 An electrical system Coordination and Short Circuit Analysis shall:

.1 Compare the calculated maximum fault current with interrupting ratings of overcurrent protective devices such as fuses and circuit breakers.

.2 Investigate applicable short circuit series ratings and the protection of electrical equipment by current limiting devices.

.3 Verify the adequacy of other equipment (such as transformers, switches, equipment bussing) to withstand the effects of the calculated maximum fault current levels.

.4 Assist in the selection and/or determination of settings for relays, fuses and circuit breakers in order to provide best coordination and minimum Arc Flash.

.5 Calculate the maximum available rms symmetrical three-phase short-circuit current at each significant location in the electrical system shall be made using a digital computer.

.6 Simulate a bolted three phase fault at each point of consideration in the system and calculate the maximum available short circuit current at that point without any reduction due to current limiting overcurrent devices which may be present.

.7 Include appropriate motor generators and transformer short-circuit contributions (contribution and transformer data) at the appropriate locations in the system so that the computer calculated values represent the highest short-circuit current the equipment will be subjected to under fault conditions.

.8 Include a tabular computer printout (three phase fault report and fault study summary) which lists the calculated short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings.

.9 Include a computer printout of input circuit data (feeder data) including conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.

.10 Include a computer printout identifying the maximum available short-circuit current (short circuit comparison tables) in rms symmetrical amperes and the X/R ratio of the fault current for each bus/branch calculation.

.11 Include a system one-line diagram which is a simplified version of the Engineer's Drawings showing only those parts of the electrical system under consideration.

.2 An Overcurrent Device Time-Current Coordination Analysis is an organized effort to determine the settings and, where appropriate, the ampere ratings and types for the overcurrent protective devices in an electrical system. The objective of the coordination analysis is to effect a time current coordination among the devices which achieves the desired system protection and electrical service continuity goals.

.1 The time-current coordination analysis shall be performed with the aid of a digital computer and shall include the determination of settings, ratings, or types for the overcurrent protective devices supplied.

.2 Where necessary, an appropriate compromise shall be made between system protection and service continuity with system protection and service continuity considered to be of equal importance.

.3 A sufficient number of computer generated log-log plots (time current curves) shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.

.4 Computer printouts shall accompany the log-log plots and shall contain descriptions for each of the devices shown on the analysis, settings of the adjustable devices, the short-circuit current availability at the device location when known, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.

.5 The study shall include a separate, tabular computer printout containing the suggested device settings of all adjustable overcurrent protective devices.

.6 Significant deficiencies in protection and/or coordination shall be called to the attention of the Owner or consultant and recommendations made for improvements as soon as they are identified.

.3 Arc-Flash Hazard Analysis

.1 The Analysis shall be performed with the aid of computer software intended for this purpose in order to calculate Arc-Flash Incident Energy (AFIE) levels and flash protection boundary distances.

.2 The Analysis shall be performed in conjunction with a short-circuit analysis and a time-current coordination analysis.

.3 Results of the Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment classes and AFIE levels.

.4 The Analysis shall be performed for minimum and maximum utility short circuit values.

~~.5~~ Analysis shall be performed upon all electrical equipment connected to transformers sized at 125kVA and above. This procedure is in accordance with IEEE Standard 1584.

.6 The Arc-Flash Hazard Analysis shall be performed in compliance with IEEE Standard 1584, the IEEE Guide for Performing Arc-Flash Calculations and NFPA 70E.

.7 The Arc-Flash Hazard Analysis shall include recommendations for reducing AFIE levels and enhancing worker safety. One or more additional reiterations of the analysis shall be performed in attempt to lower incident energy levels to desired level in consultation with the Owner and the Consultant, but not more than category 2. If the categories cannot be achieved without the change out of existing equipment, recommendations shall be provided for such new equipment to reduce AIFE levels, which may be exercised at the Owner's discretion. The recommendations shall be discussed with the Owner and the Consultant.

.8 The Contractor shall demonstrate that the forces undertaking the Arc Flash Hazard Analysis hare capable of providing equipment, services, and training to reduce Arc-Flash exposure, have trained workers in accordance with NFPA 70E and other applicable standards; and shall

demonstrate industry experience in providing equipment labels in compliance with ANSI Z535.4 to identify AFIE and appropriate Personal Protective Equipment classes and must also include the following information.

.1 Equipment Name
.2 AFIE flash hazard boundary
.3 AFIE value (cal/cm2)
.4 Hazard Risk Category
.5 System Voltage
.6 Limited Approach Boundary
.7 Restricted Approach Boundary
.8 Prohibited Approach Boundary

2 Product

2.1 NOT USED

3 Execution

3.1 NOT USED

END OF SECTION

1 General

1.1 REFERENCES AND RELATED SECTIONS

.1 Comply with the requirements of Section 26 05 00
.2 Section 26 05 21
.3 Section 26 05 24
.4 Section 26 05 31

1.2 REFERENCES

.1 CSA C22.2No.65-Wire Connectors.

.2 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters.

2 Products

2.1 MATERIALS

.1 Provide pressure type wire connectors with current carrying parts of copper sized to fit copper conductors as required.

.2 Provide fixture type splicing connectors with current carrying parts of copper sized to fit copper conductors #10 AWG or less.

.3 Provide bushing stud connectors in accordance with EEMAC 1Y-2-to consist of:
  .1 A connector body and a stud clamp for stranded copper conductors.
  .2 A clamp for stranded copper conductors.
  .3 Stud clamp bolts as required.
  .4 Bolts for the copper conductors.
  .5 Sized for the conductors as indicated.

.4 Pressure type wire connectors are to be manufactured to CSA C2.22 No. 65. Clamps and connectors are to be manufactured to CSA C22.2 No. 18.

.5 Building wire connectors shall be:
  .1 For wire sizes up to #6 AWG – Ideal “Wing Nut”.
  .2 For wire sizes #4 and larger:
    .1 End to end splices – Burndy Parallel splices – Burndy UC
    .2 At studs and bus bars – Burndy QQA (CU/AL)
    .3 Two or three conductors in parallel – Burndy Q2A or Q3Q (CU/AL).
  .3 Cable connectors shall be:
    .1 For armoured TECK cables, watertight type, with open compounded head – Thomas and Betts series “Spin-on 2” with corrosion resistant boot.
    .2 For armoured cables and steel type with nylon insulated throat – T & B “Tite-Bite”.
    .3 Clamps or connectors for armoured cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable shall be as required.

3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by Manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

.3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

1 General

1.1 REFERENCE

.1 Comply with the requirements of Section 26 05 00
.2 Section 26 05 24
.3 Conform to relevant Sections of Specifications for this and other Divisions.

1.2 PRODUCT DATA

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

1.3 STANDARDS

.1 TECK 90 cables to CSA Standard C22.2 No.131-M89.

.2 Thermostat Insulated Wires and Cables to CSA Standard C22.2 No. 38-M1986.

.3 Armoured Cable to CAN/CSA-C22.2 No. 51-M89.

.4 Thermoplastic Insulated Wires and Cables to CSA Standard C22.2 No. 75-M1983 (R1992).

.5 All cables installed in areas requiring fire rating shall conform to test FT-4.

.6 All cables installed in spaces designated as a return air plenum shall conform to test FT 6 or be installed in continuous conduit system.

.7 No “Aluminium” Wiring, Buswork or “Nual” Wiring shall be used on this Contract.

2 Products

2.1 BUILDING WIRES

.1 Conductors
  .1 Copper conductors, of the size as indicated in the Contract Documents, having a minimum conductivity of 98%.
  .2 Stranded copper conductors shall be provided for all wires sizes for this Contract.
  .3 The minimum wiring size that shall be permitted for this Contract is No. 12 AWG.
  .4 Conductors shall be minimum No. 12 AWG, size conductor for maximum 2% voltage drop to the furthest outlet on a fully loaded branch circuit.

.2 The following shall be used with respect to branch circuit wire sizing for voltage drop from the circuits associated panel board.
  .1 #12 AWG to be used from 0 to 80’, maximum length of branch circuit run from panel board.
  .2 #10 AWG to be used from 80 to 130’, maximum length of branch circuit run from panel board.
  .3 #8 AWG to be used from 130 to 220’, maximum length of branch circuit run from panel board.

.3 The Electrical Contractor shall up-size feeder and branch circuit wiring and associated conduit as required to meet the requirements of the code with respect to acceptable voltage drop.

.4 Insulation: RW90 is specified for use throughout the Contract. RW90 cable shall have thermosetting polyethylene insulation rated at a minimum of 600 V for 120/208 V wiring and 1000 V for 347/600 V wiring.

2.2 DESIGN REQUIREMENTS

.1 Number and sizes of wires and associated raceways indicated are a guide only and are not necessarily the exact number and sizes required. Wire or cable sizes smaller than indicated are not acceptable.

.2 Unless otherwise indicated, combine motor or electric heater branch power wiring (below 1000 V systems) and associated local operator control or field control device wiring into a common conduit between motor or heater and its start or motor control centre, provided all of the conditions are met:

.3 Motor circuit voltage does not exceed 600 V.

.1 Conductors and termination fittings for power and control circuits are rated 600 V minimum.

.2 Control circuits are designed to operate at 120 VAC or higher. Install wiring for control circuits operating below 100 VAC or with DC in a separate conduit system.

.3 Control circuit wiring solely associated with respective motor or heater. Install wiring for control circuits of other equipment and systems or wiring common to two or more pieces of equipment in separate conduits.

.4 Supply spare conductors in control, communication and instrumentation cable circuits as follows:

.1 20% or two spare conductors per conduit, whichever is greater or as indicated in Contract Drawings.

.5 Wire smaller than #12 gauge shall not be used except for control signals.

.6 Wire and cable shall be colour coded as follows:

.1	Power -	Black
.2	TECK 90 -	600 V and 1000V - Black
.3	Lighting - Conductor	White – Grounded, Neutral Red, Black, Blue – Ungrounded Conductor
.4	Equipment Grounding -	Green
.5	Isolated Ground -	Green/Yellow Stripe
.6	AC Control Wiring -	Red
.7	DC Wiring -	Blue

.7 Colour Coding:

.1 120/208V, circuits:

.1 Two conductors, 1 phase: 1 black, 1 white

.2 Three conductors, 1 phase: 1 red, 1 black, 1 white

.3 Three conductors, 3 phase: 1 red, 1 black 1 blue

.4 Four conductors, 3 phase: 1 red, 1 black, 1 blue, 1 white

.8 Manufacturers: Acceptable Manufacturers approved as a basis of design:

.1 Prysmian Group

.2 Nexans

.3 South Wire or

.4 Approved equal

2.3 TYPE TECK 90 CABLE

.1 Conductors
- .1 Copper conductors shall be of the sizes indicated in the Contract Documents, having a minimum conductivity of 98%.
- .2 Each cable shall have a grounding conductor.

.2 Insulation
- .1 Chemically cross-linked thermosetting polyethylene insulation rated at a minimum of 1000V, type RW 90.

.3 Inner jacket: Polyvinyl chloride inner jacket.

.4 Armour: Interlocking aluminum armour.

.5 Overall jacket: Thermoplastic polyvinyl chloride low fume smoke //LGE overall jacket for fire protection and low acid gas evolution, meeting the requirements of the Vertical Tray Fire Test to CSA Standard C22.2 No. 0.3-92 with a maximum flow travel of 1200mm. (Conform to FT4).

.6 Fastenings
- .1 One-hole malleable iron straps to secure surface mounted cables.
- .2 12-gauge galvanized steel channel type supports for two or more cables at 1500mm centres.
- .3 1/4" diameter threaded rods to support the suspended channels.

.7 Connectors
- .1 Watertight TECK connectors, T & B series 10464 and 10470.

.8 Manufacturers: Acceptable Manufacturers approved as a basis of design
- .1 Prysmian Group
- .2 Nexans
- .3 South Wire or
- .4 Approved equal

2.4 ARMOURED CABLES

.1 AC90 Cable:
- .1 Conductors: Copper conductors, of the sizes as indicated in the Contract Documents, having a minimum conductivity of 98%.
- .2 Insulation: Chemically cross-linked thermosetting polyethylene insulation rated at a minimum of 600 V.
- .3 Armour: Interlocking armour fabricated from aluminum strip.
- .4 Shall be provided with an integral insulated ground wire.
- .5 Colour Coding:
  - .1 2 conductor, 1 phase: 1 black, 1 white
  - .2 3 conductor, 1 phase: 1 black, 1 red, 1 white

2.5 MANUFACTURED PRODUCTS

.1 Comply with standards.

.2 Low Voltage Unarmoured Wire and Cable (1,000 V and Below)

- .1 Conductors: Copper conductors, of the sizes as indicated in the Contract Documents, having a minimum conductivity of 98%.
- .2 Construction: Stranded, annealed copper conductors, 1000 V, rating RWU90 cross-linked polyethylene (XLPE) insulation for all cables outside of buildings and RW90 cross-linked polyethylene (XLPE) insulation for cables within the building unless noted otherwise.
- .3 Direct buried installations or installations in direct buried polyethylene pipe: Cross-linked polyethylene (XLPE), RWU90 insulation, 1,000 V minimum rating.
- .4 Standard: CSA C22.2 No. 38.
- .5 Minimum conductor sizes: Unless otherwise indicated, #12 AWG for power and current transformer circuit.
- .6 Multi-conductor cables: PVC flame retardant jacket overall, flame test rated.

.3 Low Voltage Armoured Wire and Cable (1,000 V and Below)

- .1 Conductors: Copper conductors, of the sizes as indicated in the Contract Documents, having a minimum conductivity of 98%.
- .2 Shall be provided with an integral insulated ground wire.
- .3 Construction: Stranded, annealed copper conductors, 1000 V rating, RW90 cross-linked polyethylene (XLPE) insulation.
- .4 Power cabling: TECK construction.
- .5 Control cabling: TECK construction.
- .6 Minimum conductor size: Unless otherwise indicated, #12 AWG for power and current transformer circuits and #14 AWG for control and fire alarm circuits.
- .7 Grounding conductor: Stranded, soft, bare copper conductor in multiconductor cables, concentric copper wires over insulation in single conductor cable.
- .8 Multi-conductor cables: With inner PVC jacket.
- .9 Interlocking armour: Flexible, galvanized steel or aluminum for multi-conductor cables and aluminum for single conductors, spirally wound over inner jacket.
- .10 Outer jacket: PVC, flame-retardant, FT4 flame test rated, low acid gas evolution, outer jacket extruded over the armour.
- .11 Hazardous area installations: Where indicated, TECK cables and fittings accepted for the application. Stamp outer jacket, “HL”.

2.6 MINERAL-INSULATED CABLES

.1 Conductors: Solid bare soft-annealed copper conductors, of the sizes as indicated in the Contract Documents.

.2 Insulation Compressed powered magnesium oxide insulation to form a compact homogeneous mass throughout the entire length of the cable.

.3 Sheath:

- .1 An annealed seamless copper sheath, Type MI, rated 600 V, 250 C.

.2 Termination Kits: Provide copper termination kits at each end of each cable.

.4 Manufacturers: Acceptable Manufacturers approved as a basis of design for MI cable are:
.1 Pyrotenax of Canada Limited or approved equal.

3 Execution

3.1 INSTALLATION

.1 Install grounding, grounded and neutral conductors without any fuses, switches or breakers of any kind unless otherwise indicated in the Contract Documents.

.2 Ground the grounded or neutral conductor at the source of supply as indicated in the Contract Documents and isolate the grounded or neutral conductor at all other locations.

.3 Do not use any grounded or neutral conductors as a grounding conductor.

.4 Do not use any grounding conductor as a grounded or neutral conductor.

.5 Do not splice any wiring in any raceway. Make splices only at junction boxes.

.6 Provide sufficient slack at the connection points of conductors to permit proper connections to be made.

.7 Do not install any conductors in any raceway until the raceway is complete and cleared of all obstructions.

.8 Install all conductors in any one conduit at the same time taking care not to twist the conductors.

.9 Use wire pulling lubricants that will not shorten the life of the insulation.

.10 Do not install any wires or cables at temperatures above or below those which will cause damage to the wires or cables.

3.2 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:
.1 In conduit systems in accordance with Section 26 05 34.
.2 In wireways and auxiliary gutters in accordance with 26 05 37.

3.3 INSTALLATION OF TECK 90 1000 V

.1 Install cables as indicated.

.2 Group cables wherever possible on channels.

.3 Terminate cables in accordance with Section 26 05 20.

3.4 INSTALLATION OF ARMOURED CABLE

.1 Group cables wherever possible.

.2 Terminate cables in accordance with Section 26 05 20.

.3 Shall only be permitted for the final connection to light fixtures and the length of the drop shall not exceed 3 meters. Armoured Cable commonly known as BX shall not be permitted for any other use on this Contract.

3.5 INSTALLATION OF MINERAL INSULATED CABLE

.1 Install cable exposed, as indicated in the Contract Documents and securely supported by stainless steel straps. Strap cable every 4' along the length of the cable with stainless steel straps.

.2 Make cable terminations by using factory-made kits.

.3 At cable terminations use thermoplastic sleeving over bare conductors.

.4 Where cables are embedded in cast concrete or masonry, provide a sleeve for the entry or exit of cables.

.5 Do not splice the cables.

3.6 INSTALLATION OF FLAME GUARD (R90) TWO HOUR FIRE RATED CABLE:

.1 Install fire rated cable, as indicated in the Contract Documents securely supported.

.2 2 hour fire rated cable shall be installed in conduit with steel fitting and steel clips and to the supported maximum of every 5'-0".

.3 Do not splice the cables.

3.7 TESTING

.1 Cable and Wire – 1,000 Volt and Below

- .1 Conduct insulation resistance measurements using a "Megger" (500 V instrument for circuit up to 350 V system, 1,000 V instrument for 351-600 V systems).
- .2 Record test results in a logbook and submit to the Contract Administrator for reference. Replace or repair circuits which do not meet inspection authority requirements. With equipment disconnected, measure insulation resistance of the following circuits:
  - .1 Power, lighting, heater and motor feeders: Phase-to-phase, phase-to-ground.
  - .2 Control circuits: To ground only.
- .3 Do not perform "Megger" tests on equipment containing solid-state components.
- .4 Disconnect power factor correction capacitors from system prior to testing.

END OF SECTION

1 General

1.1 REFERENCES AND RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 05 20
.3 Section 26 05 21
.4 Section 26 05 31
.5 Section 26 05 32
.6 Section 26 05 34
.7 Conform to relevant Sections of Specification for this and other Divisions.

2 Products

Not Used

3 Execution

3.1 120/208V DISTRIBUTION & 120/208V LIGHTING

.1 Wire in conduit for all feeders and feeds to mechanical equipment.

.2 Wire in conduit for power branch circuits.

.3 Wire and conduit shall be provided for all services for this Contract.

.4 Wire in conduit for lighting circuits. Final drops to luminaires may be made with Type AC90 cable or wire in conduit. No runs of type AC90 cable shall exceed 3 meters in length. AC90 where used shall be provided with an integral insulated ground wire.

.5 Wire in conduit for dimming systems.

.6 Provide all power wiring to Systems Furniture.

.7 Provide all power wiring to Lab Case Work.

.8 Provide spare boxes for emergency lighting fixtures that maybe required by Building Inspector.

.9 Provide all power wiring to Millwork.

.10 Provide separate minimum No. 12 AWG insulated green ground wire in all conduits runs.

.11 Provide a separate No. 10 AWG neutral wire for all circuits.

3.2 600/347V DISTRIBUTION

.1 Wire in conduit for all feeders and feeds to mechanical equipment.

.2 Wire in conduit for power branch circuits.

.3 Provide separate minimum No. 12 AWG green insulated ground wire in all conduits and runs.

3.3 FEEDERS 600V & 120/208V

.1 Wire in conduit. Each feeder shall be complete with a ground wire, sized as per Ontario Electrical Safety Code.

3.4 FIRE ALARM SYSTEM

.1 Wire in conduit with approved fire rating per authorities having jurisdiction.

.2 Provide and install flexible connections to supervised valves, pressure switches, flow switches, smoke dampers, etc.

3.5 TELEPHONE & DATA COMMUNICATIONS SYSTEMS

.1 Provide blank cover plates on existing outlets as noted on Drawings and provide conduit and boxes for all new outlets.

.2 Provide pull cord in conduit system.

.3 Refer to Division 27 and meet all requirements.

3.6 SECURITY SYSTEM

.1 Provide blank cover plates on existing outlets as noted on Drawings and provide conduit and boxes for all new outlets.

.2 Provide pull cord in conduit system.

3.7 MOTOR & CONTROL WIRING

.1 Wire in conduit. Refer to Mechanical and Electrical Coordination Section in Section 26 05 00, Section 26 24 16.

3.8 VFD WIRING

.1 Drive Rx cables shall be used for remote mounted VFD’s between the VFD unit, and the motor served by the VFD, refer to Electrical Specifications Section 26 05 21.

3.9 EMERGENCY POWER FEEDER & FEEDS

.1 All emergency feeders and branch circuits and fire alarm system wiring shall have the required fire rating as per the O.B.C. (Ontario Building Code).

.2 Emergency circuits and fire alarm system wiring run in ceiling spaces or wall will have to achieve the required fire rating as per the O.B.C. (Ontario Building Code) by means of drywall enclosures or use of Mineral Insulated Copper Clad cables.

.3 Wire in conduit with approved fire rating per authorities having jurisdiction or MICC cables.

3.10 TRANSFORMERS, MOTORS & MOTOR CONTROL CENTRES

.1 Provide flexible conduit (seal tight) connections online and load side of all transformers, motors and Motor Control Center wiring.

3.11 BX CABLING (AC90)

.1 BX shall only be used for final drops to light fixtures only and the drop shall not exceed 3 meters.

.2 BX is not to be permitted for any other use on this project except in the office areas as shown on the Drawings.

3.12 CONDUIT INSTALLATION

.1 No conduits shall be installed in concrete walls, columns and slabs except embedded conduits,

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 12 17
.3 Conform to relevant Sections of Specifications for Division 26 and other Divisions.

1.2 REFERENCES

.1 Ontario Electrical Safety Code

.2 ANSI/IEEE 837-1988, Qualifying Permanent Connections Used in Substation Grounding.

.3 CSA Z32.1-M1986, Safety in Anaesthetizing Locations.

2 Products

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.2 Copper conductor: minimum 6m (20') long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size 4/0 AWG or as indicated in the Contract Documents.

.3 Rod electrodes: copper clad steel 19mm (¾") diameter by 3m (10') long.

.4 Plate electrodes: Copper surface area 0.2m², 1.6mm thick.

.5 Grounding conductors: bare stranded copper, tinned, soft annealed, size 4/0 AWG or as indicated.

.6 Insulated grounding conductors: green, type RW90.

.7 Ground bus: copper, size 6mmX50mm or as indicated in Contract Drawings, complete with insulated supports, fastenings, connectors.

.8 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  .1 Grounding and bonding bushings.
  .2 Protective type clamps.
  .3 Bolted type conductor connectors.
  .4 Thermit welded type conductor connectors.
  .5 Bonding jumpers, straps.
  .6 Pressure wire connectors.

3 Execution

3.1 INSTALLATION GENERAL

.1 Electrical material and equipment shall be transported within the site, unloaded, uncrated, handled, stored, installed (including assembly of all component parts),

and wired in accordance with the Manufacturer's instructions and recommendations and the requirements specified herein.

.2 All electrical equipment such as switchgear, generators, motors, neutral points of transformers, panels, cabinets, wiring devices, metallic raceways, armor, lighting fixtures, boxes, building structures, lightning protective apparatus, fences and gates, railroad tracks, manhole ladders and racks, and other equipment as specified on the Contract Drawings or as directed by Owner, shall be grounded by Contractor in accordance with the requirements of this Specification and the Contract Drawings.

.3 All medium voltage, low voltage integral horsepower and fractional horsepower motors (including motors remote from the ground grid) shall be grounded in accordance with the methods shown on the Contract Drawings.

.4 All conduit runs shall be grounded at enclosures of electrical distribution or control equipment at which they originate. Grounding of the cable tray systems shall be accomplished using a bare stranded copper cable attached to the outside of one vertical side of each tray. Each cable tray shall be grounded as per the OESC.

.5 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

.6 Install connectors in accordance with Manufacturer's instructions.

.7 Exposed grounding conductors shall be run to conform to the surface over which they pass. Diagonal runs shall be avoided; the runs shall be horizontal, vertical, and parallel to building walls or columns. Conductors shall be neatly and securely fastened to the mounting surface without slack using galvanized malleable iron straps or clamps. Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process or inspectable wrought copper compression connectors to ANSI/IEEE 837.

.8 Connections of ground conductors to equipment shall be by means of a lug which shall be compressed on the cable end. The lug shall be bolted to the equipment frame using holes or terminals provided by the equipment Manufacturer for this purpose. Where no such provisions are made, Contractor shall drill holes in locations designated by Owner. Hold down bolts shall not be used for ground connections. Ground connections to motors shall be bolted directly to motor frame and not to sole plates or supporting structures. At all bolted connections, the joining surfaces shall be scraped clean and coated with No-Ox-Id as manufactured by Sanchem, Inc. or approved equal compound. Soldered joints not permitted.

.9 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.10 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.11 Install separate ground conductor to outdoor lighting standards.

.12 Install grounding resistance bank if required by Contract Drawings.

.13 Connect building structural steel and metal siding to ground as per the OESC or specified in Contract Drawings

.14 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.15 Bond single conductor, metallic armored cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.16 Ground secondary service pedestals.

3.2 MANHOLES

.1 Install conveniently located grounding stud, electrode, size 4/0AWG stranded copper conductor in each manhole.

.2 Install ground rod in each manhole so that top projects through bottom of manhole. Provide with lug to which grounding connection can be made.

3.3 BUILDING ELECTRODES

.1 Make ground connections to continuously conductive underground water pipe on street side of water meter.

.2 Install water meter shunt.

.3 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.

.4 Install rod electrodes and make grounding connections as required by the OESC or specified in Contract Drawings

.5 Bond separate, multiple electrodes together.

.6 Use size 4/0 AWG copper conductors for connections to electrodes.

3.4 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of primary 600 V system, secondary 120V system.

3.5 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room.

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0 AWG.

3.6 COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:

- .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
- .2 Sound, fire alarm, intercommunication systems as indicated.

3.7 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the Consultant and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

HANGERS & SUPPORTS

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 12 17
.3 Section 26 24 13
.4 Section 26 24 16
.5 Section 26 24 17
.6 Conform to relevant Sections of Specifications for Division 26 and other Divisions.

2 Products

2.1 SUPPORT CHANNELS

.1 U shape, size 41mm x 41mm x 2.5mm (1 3/8” x 1 3/8” x 1/8”) thick, for surface mounting, suspending, or inserting into poured concrete walls and ceiling as required.

3 Execution

3.1 INSTALLATION

.1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T-bar ceilings. Ensure that T-bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.
  .1 One-hole steel straps to secure surface conduits and cables 50mm (2”) and smaller.
  .2 Two-hole steel straps for conduits and cables larger than 50mm (2”).
  .3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems.

.8 Support individual cable or conduit runs with 6mm (¼”) diameter threaded rods and spring clips:
  .1 Support two or more cables or conduits on channels supported by 6mm (¼”) diameter threaded rod hangers where direct fastening to building construction is impractical.

.9 For surface mounting of two or more conduits use channels at 5m o.c. spacing.

.10 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated in the Contract Documents or as required to support conduit and cable runs.

.11 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.12 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.13 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant provided it doesn’t violate any codes.

.14 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with Manufacturer's installation recommendations.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 05 32
.3 Section 26 05 34
.4 Conform to relevant Sections of Specification for Division 26 and other Divisions.

1.2 SHOP DRAWINGS & PRODUCT DATA

.1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 00.

1.3 STANDARDS

.1 Junction and Pull Boxes as per C.S.A. C22.2 No.40-M1989.

.2 Splitters as per CSA Standard C22.2 No. 76-M92.

2 Products

2.1 GENERAL

.1 Provide weatherproof and watertight splitters, junction and pull boxes and cabinets as indicated on the Drawings.

2.2 SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Connection bars to match required size and number of incoming and outgoing conductors as indicated in the Contract Documents.

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

2.3 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25mm (1”) minimum extension all around, for flush-mounted pull and junction boxes.

.3 PVC junction boxes shall be of a one piece moulded type.

2.4 CABINETS

.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

.2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19mm G1S fir plywood backboard (fire rated as described in Section 26 05 00) for flush mounting in finished areas and surface mounting in service and mechanical spaces.

3 Execution

3.1 SPLITTER INSTALLATION

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2m (6’ – 6”) above finished floor.

.3 Install terminal block as indicated in Type T cabinets.

.4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30m (100’) of conduit run between pull boxes.

3.3 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Install size 3 identification labels indicating system name voltage and phase.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 05 31
.3 Section 26 05 34
.4 Conform to relevant Sections of Specification for this and other Divisions.

1.2 SHOP DRAWINGS & PRODUCT DATA

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

.2 Provide samples of all floor boxes for Consultant's review.

1.3 STANDARDS

.1 Outlet Boxes, Conduit Boxes and Fittings to C.S.A. C22.2 No.18-92.

.2 Rigid PVC Boxes and Fittings to C.S.A. C22.2 No.85-M89.

2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1 and electrical code

.2 All sheet steel boxes shall have pre-punched 19mm knockouts.

.3 Do not use boxes with cable clamps.

.4 Boxes shall be minimum size 75mm x 50mm x 50mm deep. Provide 100mm square or larger outlet boxes as required for special devices. Add extension and plaster rings as required.

.5 Provide 100mm square or octagonal outlet boxes for luminaire outlets.

.6 Provide multi-gang boxes for power and switching devices, do not gang tel/data system boxes unless detailed specifically.

.7 Provide blank cover plates for boxes without wiring devices as described in Section 26 27 26.

.8 347 V outlet boxes for 347 V switching devices.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single]and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38mm (3" x 2" x 1½”) or as required for special devices or as indicated. 102mm (4") square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.2 Boxes for door switch and pushbuttons shall be sized as required.

.3 102mm (4") square or octagonal outlet boxes for lighting fixture outlets.

.4 102mm (4") square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi gang MDB boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 FLOOR BOXES

.1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 28mm (1 1/8") for receptacles; 73mm (3") for communication equipment.

.2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12mm and 19mm (½" and ¾") conduit. Minimum size: 3mm (3") deep.

2.6 CONDUIT BOXES

.1 Cast FS or FD feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle in all public areas and 1110 utility boxes in all service rooms.

2.7 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

.1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76mm x 50mm x 63mm (3" x 2" x 2½") with two double clamps to take non-metallic sheathed cables.

2.8 PVC BOXES

.1 All PVC boxes to have approved ground straps and shall be compatible with PVC conduit used.

2.9 FITTINGS – GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32mm (1¼") and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

2.10 WEATHERPROOF COVERS

.1 Light switches:

.1 Clear bubble plate with silicone rubber for use with all AC toggle switches. Hubbell Canada LP Cat No. HBL1795

.2 For locations with 2-ganged switches and/or 2-gang boxes with single switch and blank, provide custom Hubbell cover to suit requirements.

.2 Fire Alarm Manual Pull Stations:

.1 Safety Technology International inc. Series Stopper II, STI-1250 WeatherStopper Flush Mount kit. Consisting of STI-1230 clear Lexan, UV stabilized pull-station cover, STI-3002 gasket.

.2 STI Series Stopper II, STI-3150 WeatherStopper Surface Mount kit. Consisting of Consisting of STI-1230 clear Lexan, UV stabilized pull-station cover, 2xSTI-3002 gaskets, 2" STI-3100 spacer, STI-3004 Conduit insert and STI-3003 Neoprene conduit gasket.

3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits. All boxes to be hung independently of ducts, pipes, etc.

.2 Fill boxes with sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6mm (¼") of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.5 Size boxes in accordance with Ontario Electrical Safety Code.

.6 Gang boxes together where wiring devices are grouped.

.7 Provide matching blank cover plates for boxes without wiring devices.

.8 When using PVC conduit, use approved boxes.

.9 Prior to pouring concrete secure flush floor boxes to reinforcing steel, adjust level and to correct height, install cement cover securely. After pour make final adjustments.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 05 24
.3 Section 26 27 26
.4 Conform to relevant Sections of the Specifications for Division 26 and other Divisions.

1.2 REFERENCES

.1 Canadian Standards Association (CSA).
  .1 CAN/CSA C22.2 No.18-92, Outlet Boxes, Conduit Boxes, and Fittings.
  .2 CSA C22.2 No.45-M1981 (R1992), Rigid Metal Conduit.
  .3 CSA C22.2 No.56-1977 (R1977), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  .4 CSA C22.2 No.83-M1985 (R1992), Electrical Metallic Tubing.
  .5 CSA C22.2 No.211.2-M1984 (R1992), Rigid PVC (Un-plasticized) Conduit.
  .6 CAN/CSA C22.2 No.227.3-M91, Flexible Non-metallic Tubing.

1.3 LOCATION OF CONDUIT

.1 The Drawings do not show all conduits. Those shown are in diagrammatic form only. Conduits are to be provided to create complete raceway systems.

.2 No conduits shall be installed within slabs, concrete walls or columns.

1.4 NUMBER & SIZES OF CONDUITS

.1 Conduits to be provided shall be as indicated in the Contract Documents and/or as required to suit requirements of systems installed.

2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No.45, galvanized steel threaded.

.2 Epoxy coated conduit: to CSA C22.2 No.45, with zinc coating and corrosion resistant epoxy finish inside and outside.

.3 Electrical metallic tubing (EMT): to CSA C22.2 No.83, with couplings.

.4 Rigid Schedule 40 PVC conduit of the sizes indicated and required to CSA C22.2 No.211.2-M1984(R1992).

.5 Flexible metal conduit: liquid-tight flexible metal conduit of the sizes indicated in the Contract Documents and required to CSA C22.2 No.56-1977(R1992).

.6 Electrical non-metallic tubing, flexible and flexible liquid-tite included, of the sizes indicated and required to C.S.A. C22.2 No.227.1-1988, No.227.2-M1987 and No.227.3-M91.

.7 Do not use conduits smaller than 3/4" unless specifically detailed in these Documents.

2.2 CONDUIT FASTENINGS

.1 One hole malleable iron, hot dipped galvanized straps to secure surface mounted conduits. Thomas & Betts series 1275 for rigid, threaded conduit and Thomas & Betts Series 4176 for EMT complete with properly sized pan head screw.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Provide 12 gauge galvanized steel “U” channel type supports for two or more conduits on minimum 1500mm centres. Use suitable conduit clamps in channel.

.4 Threaded rods, 6mm (¼”) diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with the conduit specified with the same coating as conduit.

.2 Provide insulated bushings on all rigid, threaded conduits.

.3 Provide insulated steel set screw connectors and couplings for EMT conduits 2" and smaller, Thomas & Betts series.

.4 Provide nylon insulated concrete tight steel set screw connectors and couplings for EMT conduits 2" and smaller installed in cast-in-place concrete. Thomas & Betts 5031 and 5030 Series.

.5 Provide nylon insulated steel set screw couplings and connectors for all EMT conduits 2.5" and larger, Thomas & Betts.

.6 Provide double locknuts and a nylon insulated bushing for Schedule 40 conduit connections to sheet steel boxes and enclosures.

.7 Cast Fitting shall not be used on this project.

.8 Provide raintight connectors on conduits into panelboards and MCC’s.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with an integral bonding assembly suitable for a 100mm (4”) linear expansion.

.2 Watertight expansion fittings with an integral bonding jumper suitable for linear expansion and a 20mm deflection in all directions.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

.1 Provide fish cords to be minimum 3mm polypropylene in all feeder and branch conduit runs.

.2 Provide fish cords to be minimum 3mm polypropylene in all systems conduit runs.

3 Execution

3.1 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 No conduits shall be installed within slabs, columns or concrete walls.

.3 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.4 Do not surface mount conduits on building exterior surfaces unless otherwise indicated in the Contract Documents.

.5 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.6 Mechanically bend steel conduit over 19mm (¾") diameter.

.7 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.8 Install fish cord in empty conduits.

.9 Run 2-1" spare conduits up to ceiling space from each flush panel. Terminate these conduits in 6" x 6" x 4" (152mm x 152mm x 102mm) junction boxes at top of wall above panel. Box to be selected to suit finish required.

.10 Where conduits become blocked, remove and replace blocked section.

.11 Dry conduits out before installing wire.

.12 Use rigid, threaded Schedule 40, galvanized steel threaded conduit where specified.

.13 Use rigid PVC conduit underground for duct bank or otherwise shown within the confines of all applicable codes.

.14 Use electrical metallic tubing (EMT) in general areas except in cast concrete and below 2.4m above finished floor where not subject to mechanical injury.

.15 Use flexible metal conduit for connection to motors and transformers, connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures and work in movable metal partitions.

.16 Use liquid tight flexible metal conduit for connection to motors, transformers etc.

.17 Use flexible conduit (seal tight) connects online and load side of all transformers.

.18 Box offsets must be provided where conduits terminate at a junction box or piece of electrical equipment or distribution.

.19 The conduits for the following circuits and systems shall be run separately, except as noted in the Contract Documents and directed by the Manufacturer for some low energy systems such as CCTV and intercoms.

- .1 Normal power to luminaires
- .2 Emergency power to luminaires
- .3 Normal power to receptacle outlets
- .4 Exit lighting system

.5 Life safety system
.6 Security system
.7 Tele/data system
.8 A/V (Audio/Visual) system
.9 P.A (Public Address) system wiring
.10 CCTV system
.11 Cable TV – AM/FM
.12 Intercom system
.13 Other auxiliary systems

3.2 PVC CONDUITS

.1 PVC conduits may be bent in the field using industry approved electrical heating devices or by using the appropriate bends. Damaged or improper bends shall be replaced. All joints shall be made using an approved coupling with solvent welds. Clean all joints with solvent cleaner prior to applying the solvent. Liberally apply the solvent to the conduit fitting, force the conduit into the fitting and rotate the conduit 45° within the flange to form a tight bond. Allow proper curing time.

.2 All scorched PVC conduit shall be removed.

3.3 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5m (5') clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

.5 Do not pass conduits through structural members except as indicated or approved in writing by the Structural Consultant.

.6 Do not locate conduits less than 75mm (1 1/8") parallel to steam or hot water lines with minimum of 25mm (1") at crossovers.

3.4 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls and partition.

.3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

.1 Run conduits 25mm (1") and larger below slab and encased in 75mm (3") concrete envelope. Provide 50mm (2") of sand over concrete envelope below floor slab.

3.6 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.7 EXTERIOR

.1 Run conduit to exterior equipment as detailed in the Contract Documents.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Conform to relevant Sections of Specification for this and other Divisions.

1.2 REFERENCES

.1 Canadian Standards Association (CSA):
  .1 CSA C22.2 No.26 – 1952 (R1993), Construction and Test of Wireways, Auxilliary Gutters and Associated Fittings.

1.3 PRODUCT DATA

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

2 Products

2.1 WIREWAYS

.1 Wireways and fittings: to CSA C22 No.26.

.2 Sheet steel with hinged cover to give uninterrupted access.

.3 Finish: baked grey enamel.

.4 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

3 Execution

3.1 INSTALLATION

.1 Install wireways and auxiliary gutters.

.2 Keep number of elbows, offsets, connections to minimum.

.3 Install supports, elbows, tees, connectors, fittings.

.4 Install barriers where required.

.5 Install gutter to full length of equipment.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Conform to relevant Sections and Specification for this and other Divisions.

2 Products

2.1 CABLE PROTECTION

.1 38 x 140mm (1½" x 5½") planks pressure treated with coloured or copper napthenate or 5% pentachlorophenol solution, water repellent preservative.

2.2 MARKERS

.1 Concrete type cable markers: 600 x 600 x 100mm (2' x 2' x 4") with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

3 Execution

3.1 DIRECT BURIAL OF CABLES

.1 After sand bed specified in Section 31 23 33, is in place, lay cables maintaining 75 mm (3") clearance from each side of trench to nearest cable. Do not pull cable into trench.

.2 Provide offsets for thermal action and minor earth movements. Offset cables 150mm (6") for each 60m (200') run, maintaining minimum cable separation and bending radius requirements.

.3 Make termination and splice only as indicated leaving 0.6m (2') of surplus cable in each direction.
  .1 Underground cable splices not acceptable.

.4 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armored cables, 12 times diameter of cables or in accordance with Manufacturer's instructions.

.5 Cable Separation:
  .1 Maintain 75mm (3") minimum separation between cables of different circuits.
  .2 Maintain 300mm (12") horizontal separation between low and high voltage cables.
  .3 When low voltage cables cross high voltage cables maintain 300mm (12") vertical separation with low voltage cables in upper position.
  .4 At crossover, maintain 75mm (3") minimum vertical separation between low voltage cables and 6" (150mm) between high voltage cables.
  .5 Maintain 300mm (12") minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.
  .6 Install treated planks on lower cables 0.6m (2') in each direction at crossings.

.6 After sand protective cover specified in Section 31 23 33, is in place, install continuous row of overlapping 38 x 140mm (1½" x 5½") interlocking cable blocks as indicated to cover length of run.

3.2 CABLE INSTALLATION IN DUCTS

.1 Install cables as indicated in ducts.

.2 Do not pull spliced cables inside ducts.

.3 Install multiple cables in duct simultaneously.

.4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.5 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.

.6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.7 After installation of cables, seal duct ends with duct sealing compound.

3.3 MARKERS

.1 Mark cable every 150m (500') along cable or duct runs and changes in direction.

.2 Mark underground splices.

.3 Where markers are removed to permit installation of additional cables, reinstall existing markers.

.4 Install concrete cable markers within 180m (600') from each side of runway centre-line; 45m (150') from each side of taxi way centre-line; 50m (160') from edge of taxi ramps or aprons.

.5 Install cedar post type markers.

.6 Lay concrete markers flat and centered over cable with top flush with finish grade.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00.

.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance Tests.

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests:
- .1 Ensure that terminations and accessory equipment are disconnected.
- .2 Ground shields, ground wires, metallic armor and conductors not under test.
- .3 High Potential (Hipot) Testing:
  - .1 Conduct hipot testing in accordance with Manufacturer's recommendations.
    Leakage Current Testing:
  - .2 Raise voltage in steps from zero to maximum values as specified by Manufacturer for type of cable being tested.
  - .3 Hold maximum voltage as specified by Manufacturer.
  - .4 Record leakage current at each step.

.7 Provide Engineer with list of test results showing.

.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

1 General

1.1 SCOPE

.1 The equipment shall meet the Seismic requirements as indicated in Division 1 and structural document. The equipment and major components shall be suitable for and certified by Seismic testing to meet all applicable Seismic requirements of the latest Ontario Building Code and Canadian Electrical Code. The Manufacturer shall provide anchor bolts of sufficient size and number adequate for the seismic conditions.

1.2 RELATED SECTIONS

.1 Read and conform to:
- .1 The General Conditions of the Contract.
- .2 Comply with Division 1 requirements and Documents referred to herein.
- .3 Comply with all Sections of Division 26.

1.3 WORK INCLUDED

.1 This Section provides minimum acceptance requirements for vibration isolation and seismic restraints for all electrical equipment and associated systems.

1.4 QUALITY ASSURANCE

.1 Unless otherwise directed by the local authority having jurisdiction, the following codes and standards will apply:
- .1 National Building Code of Canada
- .2 Canadian Electrical Code

1.5 SUBMITTALS

.1 All vibration isolation and seismic restraint systems shall be by one Manufacturer.

.2 Submit shop drawings for all devices specified herein and as indicated on the Drawings. Shop drawings for electrical supports and anchorage shall be stamped and signed by a Professional Engineer licensed in the Province of Ontario for seismic design. Submittals shall include dimensions, materials, attachment and anchorage requirements. Indicate compliance with each Specification item herein.

.3 Provide calculations for selection of seismic restraints, certified and stamped by a qualified Professional Engineer licensed in the province. Electrical equipment supports and anchorage shall be capable of withstanding seismic forces in conformance with the requirements of the National Building Code of Canada and CSA S832-06. Design calculations shall use the following parameters:
- .1 Building site classification for seismic site response is E.
- .2 Earthquake importance factor for the building, IE, is 1.5, as classified as Post-disaster.
- .3 Spectral response acceleration for short periods, Sa(0.2): See table below.
- .4 Spectral response accelerations for 0.5 and 1-second periods, Sa(0.5) and Sa(1.0), are: See table below.

.5 Importance factor for wind load, IW (ULS) is 1.25, as classified as Post-disaster.
.6 The reference hourly wind velocity pressure, q, in kPa, is 0.47.
.7 Fa: See table below.
.8 Fv: See table below.

Importance Category	Post-Disaster	Normal
Earthquake		
Site Classification	E	E
Importance factor, earthquake, $\mathbf{I_E}$	1.50	1.00
Sa (0.2)	0.096	0.096
Sa (0.5)	0.063	0.063
Sa (1.0)	0.035	0.035
Sa (2.0)	0.017	0.017
Sa (5.0)	0.0041	0.0041
Sa (10.0)	0.0017	0.0017
PGA	0.057	0.057
PGV	0.048	0.048
FA	1.64	1.64
Fv	2.81	2.81
Wind		
Hourly wind pressure (1/50), q:	0.47 kPa	0.47 kPa
Importance factor, wind ULS, $\mathbf{I_W}$	1.25	1.00
Importance factor, wind SLS, $\mathbf{I_W}$	0.75	0.75

.4 Product Data: Provide schedule of vibration isolator type with location and load on each.

.5 Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.

.6 Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

1.6 SEISMIC ENGINEER

.1 Professional Engineer holding a Certificate of Authorization in the Province of Ontario with a minimum of 5 years' experience in seismic design.

.2 At the completion of the project, the supplier of the Electrical Vibration and Isolation including Seismic restraint equipment installed on site, employed Seismic Engineer, shall review the installations, and shall prepare a written report, with a sealed letter, certifying that the installations have been completed in accordance with their design and shop drawings. These sealed documents will be supplied to the appointed Contractor.

1.7 PROJECT RECORD DOCUMENTS

.1 Record actual locations of seismic restraints including attachment points.

1.8 MANUFACTURER

.1 Vibro-Acoustics.

.2 Eaton B-Line Series (TOLCO Seismic Bracing and Cal-Dyn Vibration Isolation)

.3 Or, approved equal.

2 Products

2.1 VIBRATION ISOLATION

.1 Springs: All springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. All springs except internal nested springs shall have an outside diameter not less than 0.8 of the compressed height of the spring. Ends of springs shall be square and ground for stability. Laterally stable springs shall have kx/ky ratios of at least 0.9. All springs shall be fully color-coded to indicate capacity - color striping is not considered adequate.

.2 Corrosion Protection: All springs shall be powder-coated enamel. Housings and bases shall be galvanized, powder-coated enamel, or painted with rust-resistant paint. Hot-dipped galvanized housings shall be provided as needed.

.3 Steel Equipment Base: Bases shall be of welded construction using structural steel with cross members to form a rigid, integral support platform. Structural steel members shall be designed to match supported equipment.

.1 Height-saving brackets or welded steel pockets shall be incorporated to ensure a 1" (25mm) minimum clearance under each steel base.

.4 Concrete Inertia Base: Inertia bases shall be of welded steel construction with concrete in-fill supplied by the installing contractor on site and shall incorporate 15M (No.4) reinforcing bars, welded 12" (300mm) maximum on centers each way.

.1 The weight of each inertia base shall be at least equal to the weight of the equipment mounted thereon or sufficient to lower the center of gravity to or below the isolator support plane.

.2 Inertia bases shall be a minimum of 4" (100mm) thick.

.3 Height-saving brackets or welded steel pockets shall be incorporated to ensure a 2" (50mm) minimum clearance under each inertia base.

.5 Isolators:

.1 Open Spring Floor Mounts: Free-standing, laterally stable, unhoused spring type with leveling bolts for bolting to the equipment. Springs shall be supported either with a neoprene cup or a metal base plate complete with a neoprene noise isolation pad bonded to the base plate.

.2 Restrained Spring Floor Mounts: Laterally stable, vertically restrained spring type with housings and heavy top plates for supporting the equipment. Springs shall be supported either with a neoprene cup or a metal base plate complete with a neoprene noise isolation pad, bonded to the base plate. Housings shall be of welded steel construction and include vertically restraining limit stops.

.3 Top plate and restraining bolts shall be out of contact with the housing during normal operation and neoprene grommets shall be incorporated to minimize short-circuiting of restraining bolts.

.4 Closed Spring Floor Mounts: Laterally stable, housed spring type with heavy top plate and leveling bolts for bolting to the equipment. Springs shall be supported either with a neoprene cup or a metal base plate

complete with a neoprene noise isolation pad. Housings shall be fabricated or welded steel telescoping housings that incorporate neoprene stabilizers to minimize short circuiting and provide vertical damping.

.5 Rubber in Shear Floor Mounts: "Double-deflection" neoprene type, with neoprene-coated metal surfaces, and top and bottom surfaces ribbed. Isolators shall have bolt holes in the base.

.6 Spring Hangers: Spring hanger with steel spring and welded steel housing. Hangers shall be designed for a minimum of 15° angular misalignment from vertical before support rod contacts housing. Isolators with the addition of a neoprene element in series with the spring. Provide vertical uplift stopwasher on spring hangers for seismically restrained equipment.

.7 Rubber Hanger: Double-deflection neoprene hanger type, with neoprene grommet between hanger rod and housing. Neoprene element shall have neoprene-coated metal surfaces.

.8 Isolation Pads: Neoprene pad type ribbed on both sides. Neoprene pad type ribbed neoprene pad bonded to one side of minimum 10 gauge (3.5mm) metal plate. Sandwich neoprene pad type ribbed neoprene pad bonded to each side of minimum 10 gauge (3.5mm) metal plate. Sandwich neoprene pad type, with alternating layers of ribbed neoprene pad and minimum 10 gauge (3.5mm) metal plate, bonded together. Isolator pads shall be selected for less than 80% maximum rated load.

2.2 SEISMIC & WIND RESTRAINTS

.1 Vibration isolators with integral seismic restraint: Floor mounted isolators shall meet the requirements as listed above. For those devices intended to provide restraint from seismic and wind forces, housings shall be capable of withstanding the applicable design forces for the specific installation.

.1 Seismic Spring Floor Mounts: Laterally stable, restrained spring type with support plate for bolting to the equipment. Springs shall be supported either with a neoprene cup or a metal base plate complete with a neoprene noise isolation pad bonded to the base plate. Mount shall include integral all-directional limit stops with elastomeric grommets preventing metal-to-metal contact and with minimum 1/8" (3mm) clearance under normal operation.

.2 Seismic Restrained Spring Isolator: Laterally stable, restrained spring type with housings and heavy top plates for supporting the equipment and resisting seismic and wind loading. Housings shall be of welded steel construction and include vertically restraining limit stops. Top plate and restraining bolts shall be out of contact with the housing during normal operation and neoprene grommets shall be incorporated to minimize short-circuiting of restraining bolts.

.3 Seismic Restrained Neoprene Mount: Neoprene type, including steel baseplate with mounting holes for anchors. Isolator shall include leveling and restraining bolt for mounting to the equipment and prevent metal-to-metal contact of the restraining bolt to the baseplate.

.2 Seismic Cable Restraints: Seismic cable sway bracing restraints shall consist of 7x19 galvanized steel aircraft cable sized to resist seismic loads tested by a third

party in compliance with CBC 2010 1715A.3.1 and ASCE 7-10 Section 1.3.1.3.2 load factors. Cable end connections shall use heavy brackets, thimbles, and wire rope clips or compression sleeves, as required by the test setup.

.3 Hanger Rod Stiffener: 12 Gauge Bolted framing 1X5/8" x 1X5/8" channel attached with a steel bracket and break-off torque bolt. Structural steel angle attached with a formed steel clamp to threaded rod support.

.4 Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications.

.5 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. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications.

3 Execution

3.1 GENERAL

.1 Coordinate size, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation and seismic restraint devices. Ensure housekeeping pads have adequate space to mount equipment and isolator housings and shall also be large enough to ensure adequate edge distance for isolator anchor bolts to avoid housekeeping pad breakout failure.

.2 Coordinate locations and sizes of structural supports with locations of vibration isolators and seismic restraints (e.g., transformers, load banks, engine-generator sets, switchgears, switchboards, MCC's, panels, etc.).

.3 Bolt all floor mounted switchgear, panelboards and transformer enclosures to the concrete pads through the channel iron supports running along the back and front of the enclosures. Use not less than four bolts per meter of length (2 front - 2 back). On the large switchgear and transformer assemblies use bolts not less than 16mm in diameter.

.4 For bus duct, cable tray, and conduit runs supported with rod and channel iron use rod hangers not less than 13mm in diameter.

.5 For lighting fixtures:

.1 Fasten recessed fixtures firmly to the suspended ceiling system with attachment devices capable of 100% of the fixture weight acting in any direction.

.2 For recessed fixtures in inverted T-bar ceiling systems, use Caddy #ATS-41 or equal, attachment clips. Provide minimum of four clips per fixture, fastened to adjacent main runner members of T-bar system.

.3 For recessed fixtures weighing more than 9kg (20lbs) but less than 25kg (56lbs), in addition to the requirements of 3.1.5.1 and 3.1.5.2 above provide two #12 gauge steel wire hangers per fixture, with one end fastened to the fixture housing and the other end to either the ceiling system hanger or to the building structure above. These wire hangers may be slack.

.4 For recessed fixtures weighing more than 25kg (56lbs), support directly from the building structure above, independent of the suspended ceiling system, using approved hangers.

.5 Fasten surface mounted fixtures to the ceiling system with positive clamping devices which completely surround the supporting members. Provide safety wires between the clamping device and the adjacent ceiling system hanger or to the building structure above. Caddy fasteners type IDS or equal, for securing surface mounted fluorescent fixtures to inverted T-bar systems, with #12 gauge steel wire hangers to the structure above.

.6 Support pendant type fixtures directly from the building structure above, using #9 gauge steel wire without using the ceiling suspension system for direct support.

.6 Install all seismic restraint devices in accordance with the Manufacturer's instructions and drawings.

END OF SECTION

1 General

1.1 SCOPE

.1 Provide commissioning of electrical systems provided under Division 26 and 28.

.2 The Contractor shall perform electrical system installation, start-up, testing, preparation of O&M manuals and operator training, and the coordination of the commissioning process the responsibility of the General Contractor.

.3 Include all labor and material as required to participate in the commissioning process, as outlined in this Section, for equipment installed under Division 26 and responsibilities prescribed for the Electrical Contractor in Division 1 - General Commissioning Requirements.

1.2 RELATED WORK

.1 Commission electrical equipment and systems in conjunction with: Specification Section of Division 1 - General Commissioning Requirements.

.2 This Section of the Specification shall be read in conjunction with all other Sections of the Division 26, and 28 - Electrical Specifications, which include details of specific tests / inspections to be performed on various equipment /systems in addition to those specified in this Section.

1.3 COORDINATION

.1 Coordinate the work of this Section with all other Divisions to ensure complete and operational electrical systems at completion of this work.

.2 Review the design intent of the project and the intended operation of systems with Fire Training Facility representative and the Consultant before proceeding with commissioning.

1.4 COMMISSIONING PROCESS

.1 Commissioning Mandate for Electrical Systems: to ensure that all project systems perform interactively and in strict accordance with the design intent, LEED requirements and latest OESC requirements for life safety equipment and Owner’s operational needs as set forth in the Contract Documents.

.2 Commissioning procedures are in accordance with this Section.

.3 The Commissioning process develops, coordinates, and documents the following:

- .1 Shop drawings and record drawings
- .2 Start up, installation inspection and equipment verification and/or system and calibration
- .3 Check sheets and testing forms
- .4 Testing of equipment and systems
- .5 Functional and Performance Testing
- .6 Commissioning meetings and reporting
- .7 Operation documentation
- .8 Operator training

.9 Warranties

.4 The Commissioning Program is divided into the following parts:
- .1 Part 1: Shop drawings and record drawings
- .2 Part 2: Factory Testing
- .3 Part 3: Pre-Start and Start-Up testing
- .4 Part 4: Installation Verification testing
- .5 Part 5: Functional testing
- .6 Part 6: Systems Operating Manuals
- .7 Part 7: Operator Training
- .8 Part 8: Warranties

1.5 WORK INCLUDED

.1 Commissioning work of Division 26 includes, but is not limited to:
- .1 Shop drawing review for Mechanical and Electrical coordination.
- .2 Participation in regular construction meetings as well as separate Commissioning Meetings during the construction period associated with the scheduling, coordination, and implementation of the various commissioning activities within the overall construction program.
- .3 Factory Testing of equipment as described under various equipment Specifications.
- .4 Site Testing and start-up of equipment.
- .5 Detailed acceptance testing as described under various equipment Specifications including supplementary testing required by Commissioning Authority.
- .6 Cooperation with the Commissioning Authority in developing and implementation of the commissioning plan.
- .7 Providing qualified personnel for participation in implementing commissioning test procedures.
- .8 Providing equipment, materials, and labor as necessary to correct construction and/or equipment deficiencies found during the commissioning process.
- .9 Providing operation and maintenance manuals and as-built drawings to the Commissioning Authority for verification in a timely manner.
- .10 Providing training and demonstrations for the systems specified in this Division prior to turnover to Owner.

.2 Conduct complete and thorough evaluation and documentation of the operation and performance of all components, systems, and sub-systems, including the following equipment and systems:
- .1 Service entrance low voltage switch board
- .2 Main Power Transformer
- .3 Low Voltage Distribution panel
- .4 Automatic Transfer Switches
- .5 Power Generation Diesel
- .6 Dry Type Transformers primary up to 600V
- .7 Fire Alarm System
- .8 Power and lighting panels
- .9 Grounding System
- .10 Lighting System

.11 Emergency Lighting System
.12 Lighting Control System
.13 Power Monitoring System

.3 Commission all equipment supplied under the Contract by the Contractor, as well as any equipment, pre-purchased, or pre-ordered by the Owner. Provide skilled trades people to operate various related electrical equipment in support of the commissioning program.

.4 Commission services to equipment, but not the equipment itself, where the supply of the equipment does not form part of the electrical Work. Provide skilled trades people to operate various related electrical equipment in support of the commissioning activities of other trades.

.5 Provide the following commissioning documentation:
.1 Recording completed Pre-start and Start-up procedures test results
.2 Record completed Installation Verification and Performance Validation, as well as Functional test results, and Certificates
.3 As-built records
.4 Operation and maintenance manuals

.6 The final commissioning report will be prepared by the Commissioning Consultant.

1.6 EXCLUDED WORK

.1 Unless otherwise specified, equipment which is not supplied by the Electrical Contractor or their sub-trades, where the value for the supply of equipment is not included as part of the Work, such as:
.1 Supplied by Owner (SBO) equipment,
.2 Equipment marked Not in Contract (NIC) or Not in Electrical Contract (NIEC).

1.7 REQUIRED INFORMATION AND COMMISSIONING PREREQUISITES INFORMATION

.1 A complete shop drawing submission schedule shall be submitted to the Commissioning Authority.

.2 Approved construction administration shop drawing shall be submitted to the Commissioning Authority two weeks before the production release of each item.

.3 A complete set of accurate "as built" drawings must be transmitted to commissioning consultant/authority a minimum of 31 Days prior to the anticipated date of Substantial Performance of the Work.

.4 A copy of all equipment Specifications must be transmitted to Commissioning Consultant a minimum of 31 Days prior to the anticipated date of Substantial Performance of the Work.

.5 All "sequence of operation" narratives must be submitted to the Commissioning Consultant a minimum of 31 Days prior to the anticipated date of Substantial Performance of the Work.

.6 A copy of all Factory Acceptance Test (FAT) reports must be completed, reviewed by the Consultant, and transmitted to Commissioning Consultant a minimum of 31 Days prior to the anticipated date of Substantial Performance of the Work.

.7 A copy of all site startup reports must be transmitted to the Commissioning Consultant a minimum of 5 Working Days prior to the anticipated date of Substantial Performance of the Work.

1.8 DEFINITIONS

.1 Major deficiency – an item which if not corrected renders the equipment or system unsuitable or un-safe for use by the Owner. Major deficiencies must be corrected as a condition for achieving Substantial Performance of the Work.

.2 Minor deficiency – an item which does not impact on the operation of the equipment or system and will allow the Owner to use the system safely. Minor deficiencies may be corrected before or after Substantial Performance but will not prevent certification of Substantial Performance of the Work.

1.9 COMMISSIONING SCHEDULE

.1 Provide a detailed commissioning schedule for consolidation into the main construction schedule.

.2 Include:
- .1 equipment and systems start-up predecessors
- .2 Time periods for pre-start and start up testing, verification and validation testing for each equipment and system.

1.10 DOCUMENTATION DELIVERABLES

.1 Identify documents including test documents, binder covers, etc. using equipment ID numbers provided on equipment schedules.

.2 Scan original signed test reports, including verification and performance and / or functional test reports, manufacturers service reports, etc. in Adobe Acrobat *.pdf version 8 format. For original document chapters, provide Adobe chapter referencing.

.3 Submit three copies of each completed and accepted Verification and Functional Performance Test reports, both preliminary and final issues.

.4 Collate final, accepted and signed test results in separate binders as follows:
- .1 Electrical Systems
- .2 Fire Alarm Systems

.5 Provide three CD-R or DVD-R copies of commissioning documentation.

1.11 SUBSTANTIAL PERFORMANCE

.1 Refer to project commissioning requirements specified in the Contract Documents.

.2 Application for Substantial Performance of the Work is contingent on the Work being ready for Owner's use which includes completion of the following commissioning elements:

.1 Start-Up and testing

.1 Commissioning Verification testing including submission of completed records,

.2 Commissioning Performance Validation testing including submission of completed records, except for alternate season tests,

.3 Commissioning Controls Validation testing,

.4 Training of Owner's operations personnel,

.5 As-built documentation issued for Consultant's review,

.6 Operations and Maintenance manuals which have been reviewed by the Consultant and accepted by the Owner.

1.12 TEST EQUIPMENT

.1 The Contractor shall provide all labour and materials, tools and equipment required during the various stages of pretesting, startup, and commissioning processes.

.2 Provide any test equipment and software required for pretesting and start-up, whether specified or not.

.3 Ensure that the Manufacturer provides test equipment and personnel as required for the startup and testing of their equipment and assists in the commissioning process as needed.

.4 Ensure that Manufacturer provides test equipment, demonstrates its use, and assists in the commissioning process as needed.

2 Organization

2.1 GENERAL

.1 Complete all phases of work so that the systems can be started, tested, and verified for alarm or status monitoring by the Building Automation System (BAS) and fire alarm systems as applicable, and the Commissioning procedures can be undertaken in a timely manner such that only one acceptance test is conducted at any one time. Provide supplementary testing as required to ensure all BAS and fire alarm system monitoring of electrical equipment status points are verified to demonstrate all operating status and alarm conditions.

.2 Participate and assist in the development of the Commissioning Schedule by the Construction Manager, by providing necessary information pertaining to the equipment and installation. Provide commissioning schedule information to be incorporated into the overall Construction Plan Schedule.

.3 Acceptance procedures may begin prior to completion of a system and/or sub-system. Start of acceptance procedures before system completion does not relieve the Contractor from completing those systems in accordance with the commissioning and construction schedule.

2.2 PARTICIPANTS

.1 Commissioning Team consists of multiple parties with separate responsibilities.

.2 Owner:
- .1 establishes acceptance criteria,
- .2 provides operations staff to receive training, and to witness any or all tests at their discretion,
- .3 Final acceptance of commissioning results.

.3 Consultant:
- .1 Responsible for the construction review activities in accordance with local building code and safety requirements,
- .2 May participate in development and / or review of commissioning procedures,
- .3 reviews pre-startup, testing, and commissioning test results,

.4 General Contractor and the Consultant
- .1 Develops and/or approves the commissioning plan and procedures,
- .2 Coordinates Owner's commissioning team members who witness tests,
- .3 Witnesses commissioning tests to confirm compliance by the Contractor to the Commissioning Plan,
- .4 Reviews commissioning test results and makes recommendations to the Owner and/or Acceptance Authority for acceptance,
- .5 Monitors the progress of the commissioning work and reports to the Owner.
- .6 Accepts the commissioning test results on behalf of the Owner.

.5 General Contractor:
- .1 Coordinates and manages commissioning activities,
- .2 Develops and integrates commissioning activities into the construction schedule,
- .3 Ensures commissioning procedures are completed and documented, and commissioning records including any required attachments are submitted.

.6 Contractor:
- .1 Provides the services of qualified Technician(s) who are familiar with the construction and operation of the system, to start-up and debug equipment and systems within the Division 26 scope of Work. Include work of independent testing Contractors, ITC. Include for labour, materials, and subsistence costs for these same Technicians to assist the Commissioning Authority in completing the commissioning program.
- .2 Provide access to the contract plans, shop drawings, and equipment cut sheets of all installed equipment.
- .3 Ensures the qualified Technician(s) are available and present during commissioning testing to complete the tests, make adjustments and to assist in problem resolutions.
- .4 Should any equipment or system experience performance problems and/or reconstruction or replacement is required, include for additional Technician time for subsequent retesting of systems until required system performance is achieved.
- .5 The Commissioning Authority reserves the right to approve proposed Technicians with regard to the technical skill level required for each type

of equipment and/or system, and willingness by the individual(s) to work within the Commissioning Group.

.6 Provides a Foreman Electrician familiar with the electrical interlocks, interfaces with emergency power supply, and interfaces with BAS, alarm, and life-safety systems. Provide access to the contract plans, and all as-built schematics of sub-systems, interfaces and interlocks.

.7 Independent Testing Contractor

.1 The Independent Testing Contractor (ITC) shall be hired by the Electrical Contractor to provide the coordination study, the Arc Flash study, testing, verification and calibration of the electrical system, and to issue reports to the Design Consultant and Commissioning Authority.

.2 The ITC shall conduct, as detailed in the Specification 26 05 10, the Arc Flash study, and a coordination study and issue a report as a shop drawing submission and also provide testing, verification and calibration of the electrical system and issue reports to the Design Consultant and Commissioning Authority.

.8 Equipment suppliers:

.1 Provide the services of Manufacturers' service personnel to provide assistance with pre-start and initial start-up of the equipment, and to undertake operation of equipment as part of the acceptance and commissioning testing program as required.

3 Execution

3.1 COMMISSIONING MEETINGS

.1 Participate in periodic commissioning team meetings, and trade commissioning meetings.

.2 Construction and Post-Construction:

.1 Participate in commissioning meetings as scheduled by the Construction Manager.

.2 participate in trade commissioning meetings as required, in addition to the regular commissioning team meetings,

.3 Identify to the commissioning group problems relating to the commissioning schedule, identification of start-up issues, etc., and participate in the resolution of these problems.

3.2 COMMISSIONING PROCEDURES

.1 The commissioning process shall meet the requirements of ANSI/NETA ATS – 2009 Standards for Acceptance Testing of Electrical Systems except as specifically modified by this Specification.

.2 The Contractor shall prepare a detailed Commissioning Schedule for commissioning of all electrical systems and equipment in coordination with the Construction Manager's schedule and to the approval of Commissioning Authority. Update the schedule as appropriate through the construction period.

.3 Shop Drawings and Record Drawings

.1 Prepare record documentation for each equipment installation covering:

.1 Equipment identification and Supplier.
.2 Shop Drawing submittal, review, production release coordination, and delivery dates.
.3 Dates for completion of all work required preparing for equipment installation.
.4 Dates for equipment installation, supplier prestart checkout, and system availability for start-up.
.5 Dates for equipment start-up, performance testing, proposal for temporary use, acceptance testing, demonstration, turnover and warranty start / finish.

.2 Submit proposed record sheets and procedures to Commissioning Authority for review and approval.
.3 List all specialist personnel and equipment required for the tests and ensure that these are available by the test dates.
.4 Provide documentation of the commissioning process and include in maintenance manuals. These are to include check sheets, equipment data sheets, start-up certificates from suppliers involved in start-up, and documentation concerning demonstration to the Owner's O&M Personnel. Include all record and result sheets from commissioning tests.
.5 Maintain a log of key operating parameters, problems encountered, solutions employed and verification of effectiveness of solutions. Include log in maintenance manuals.
.6 Submit templates for all documentation including record sheets, check sheets, commissioning reports etc. to Commissioning Authority for approval. Meet Commissioning Authority's requirements for level of reporting.

.4 Check sheets and Testing Forms
.1 The Contractor and Manufacturers shall fill out the check sheets and test forms listed in this Section or provide other forms. The Consultant and the Region must approve the forms before they are used.
.2 The Commissioning Authority will randomly confirm that check sheets are complete and accurate. In the event that false or incomplete check sheets are submitted, ALL check sheets will be rejected. The Contractor will be required to resubmit new check sheets for all similar systems. All cost incurred by the Contractor with processing and rechecking false or incomplete check sheets will be to the Contractor's account.

.5 The Owner's designated Commissioning Authority provides the approved commissioning procedures (checklists, etc.) for use by the Contractor.

.6 Each commissioning procedure tests the equipment and systems, and consists of the following elements:
.1 Document sign-off
.2 Pre-start and Initial test
.3 Installation Verification - Equipment
.4 Installation Verification - Systems
.5 Performance Validation
.6 Appendices

.7 Document Sign-Off:
.1 each completed procedure is signed off by the following parties:

.1 Contractor, for testing.
.2 Independent testing organization for review of factory test report, witness the factory testing and testing.
.3 Commissioning Authority/Consultant, for review and witnessing,
.4 Owner, for test acceptance.

.8 Pre-Start and Initial Test:
.1 Checklists included: confirmation of authority's inspections, pre-start safety checks (where applicable), system cleaning and pressure testing, and confirmation of availability of supporting systems.

.9 Installation Verification - Equipment
.1 Checklists to verify the installation of equipment, including design Specification requirements, Drawing requirements, Manufacturer installation requirements, and other experience-related items.
.2 Use of pre-printed Manufacturer installation and start-up checklists are permitted and encouraged; however, the commissioning procedure checklists may contain supplemental items.

.10 Installation Verification - System:
.1 Checklists to verify the installation of the system associated with the equipment.

.11 Functional Test Plans:
.1 Specific test procedures and record documentation requirements for performance measurements of the various systems.

.12 Appendices:
.1 Collate test reports from authorities having jurisdiction, Manufacturer start-up and test reports, balancing reports, etc.

3.3 COMMISSIONING TEST METHODOLOGY

.1 Step 1: Notify the required attendees in accordance with an agreed schedule and notification period when testing will begin on each procedure type. The Commissioning Consultant will witness the testing on an audit basis, including the first instance, the last instance, and at random during other times.

.2 Step 2: complete the commissioning procedures including recording results, and sign-off and date separately the completion of Part "A" Verification, and Part "B" Validation. Any deficiencies discovered during this testing are to be corrected prior to sign-off of the test.

.3 Step 3: on completion of systems which do not require witness demonstration, finalize the report and submit to the General Contractor for review.

.4 Step 4: on completion of systems which have been witnessed by the required reviewers the General Contractor is to sign-off the completed procedure document as being witnessed.

3.4 COMMISSIONING IMPLEMENTATION

.1 Conduct operating tests and checks to verify that all components, equipment, systems, and interfaces between systems, operate in accordance with Contract Documents.

.2 Demonstrate and verify operating modes, interlocks, specified control sequences, specific responses to abnormal or emergency conditions, and verification of the proper response to the Building Automation System, security system, and fire alarm system as applicable.

.3 Roles and Responsibilities:

Organized by:	**Construction Manager**
Approved Test sheets provided by:	Commissioning Authority
Testing Conducted by:	Contractor Equipment Suppliers Technical Personnel as appropriate Independent Testing Organization as specified
Testing recorded by:	Contractor Equipment Suppliers Technical Personnel as appropriate Independent Testing Organization as specified Commissioning Authority
Tests witnessed by:	Commissioning Consultant/Authority Owner (selected tests)
Reports reviewed by:	Construction Manager Commissioning Consultant/Authority Design Consultant
Reports Accepted by:	Owner

3.5 OPERATING CHECKS

.1 The Commissioning Consultant witnesses equipment and system tests.

.2 Set the system equipment into operating mode to be tested including but not limited to:
- .1 Normal start up, operation, and shutdown
- .2 Normal auto position
- .3 Normal manual position
- .4 Unoccupied cycle
- .5 Emergency power operation, including transition states
- .6 Status and Alarm conditions

.3 Inspect and verify the position of each device and interlock identified on the checklist.

.4 Repeat the above tests for each operating mode that applies to the system being tested.

.5 For failed test items, provide appropriate comments to the checklist data sheet and classify whether it is a “Major” or “Minor” deficiency.
- .1 The Consultant retains the right to make the final decision regarding classifications of deficiencies.

.6 Test failure is defined as:
.1 Refer to relevant Specification Sections.

.7 Acceptance
.1 The final reports will be reviewed by the Commissioning Consultant and the Consultant, to determine if verification is complete and the operating systems are functioning in accordance with the Contract Documents.
.2 The Commissioning Consultant, in conjunction with the Consultant, reviews and makes final classification of all noted deficiencies. Correct deficiencies classified as “Major” before acceptance of the Verification stage.
.3 The Owner will make the final acceptance of test results.

3.6 FUNCTIONAL VALIDATION TESTING

.1 Conduct performance / functional tests and checks to validate that equipment and system components are providing the required functionality (capacity) for each equipment and system.

3.7 PROBLEM RESOLUTION

.1 In the event that additional work is required to correct either systems, misapplied or improperly installed equipment, and/or deficient performance under varying load conditions, assist the Owner and Commissioning Consultant in developing an acceptable resolution to the problem, including the resources of equipment Suppliers.

.2 The Owner has final approval over any additional work required to achieve the required level of performance.

.3 Complete corrective work in a timely fashion to permit the completion of the commissioning process.

3.8 ACCEPTANCE

.1 Any identified deficiencies will be reviewed by the Consultant in conjunction with the Construction Manager to determine if correction of the deficiency is as a result of a defect in the equipment or installation.

.2 If it is determined the performance deficiency is as a result of a defect in the equipment or its installation, rectify the deficiency and repeat the functional test until the required performance levels are functionality is achieved.

.3 If it is determined the equipment or system has been constructed in accordance with the Contract Documents, the Owner will decide whether to accept the functionality as is or direct the installation Contractor to make changes to the system as required to obtain performance levels which meet the design intent and retest the system.

3.9 POST-SUBSTANTIAL COMMISSIONING

.1 Provide commissioning after Substantial Performance of the Work:
.1 Functional testing which is weather or live-load dependent;

.2 For out-of-season system functional testing, conduct initial functional tests to demonstrate off-peak load performance. Schedule peak load performance testing over the succeeding 9 months to ensure all equipment is tested at peak load prior to the expiry of the warranty period.

.3 Infra-red thermal imaging of equipment under peak building live-load conditions,

.4 Alternatively, provide temporary equipment (load banks, etc.) to simulate full load conditions. Submit proposed methodology for review by the Commissioning Authority and Consultant.

3.10 ADDITIONAL COMMISSIONING

.1 Additional commissioning activities may be required after completion of system functional testing. Include in the tender cost a reasonable reserve to complete this work, including assistance from Manufacturers' Service Technicians.

3.11 SYSTEMS OPERATING MANUALS

.1 Provide Operating and Maintenance Manuals in accordance with the requirements of Division 26.

.2 The Systems Operating Manuals (SOM) are in addition to the Operating and Maintenance Manuals (OMM) required under Section 26 05 00.

.3 Conform to the specification Section 26 05 00 for the requirements of the O&M manuals. Documents such as system description, sequence of operation (including start-up and shut-down procedures) shall be compiled by the Contractor from the Specification, Drawings and approved shop drawings and included in the manuals after Consultant's approval.

.4 Included a list of spare parts, special tools, lubricants, etc. for each item of equipment, which has been purchased as part of the Contract.

.5 Provide a list of recommended spare parts for all equipment installed under Divisions 26, 27 and 28 to cover a period from Substantial Performance of the Work to Warranty end.

.6 Provide at minimum, the following information for recommended spare parts:

.1 Manufacturer's name, address, phone and fax numbers.

.2 Manufacturer's part name, part number, unit price, lead time, shelf life.

.3 Quantity recommended for 1 year.

.4 Alternative suppliers of compatible parts, including local Supplier name, address, phone and fax numbers.

.7 Submit preliminary list of spare parts and tools to Owner to a minimum of 30 Days prior to intended system handover to Owner. The Owner reserves the right to add to, reduce, or omit entirely, the recommendations contained on these lists.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 05 03
.3 Section 26 05 10
.4 Section 26 05 24
.5 Section 26 05 28
.6 Section 26 05 29
.7 Conform to relevant Sections of Specification for Division 26 and other Divisions.

1.2 STANDARDS

.1 Design, manufacture and test the dry type transformers in accordance with good industry practice and in accordance with the following Standards:

.2 CSA C22.2 No.47 and CSA C9 – Dry Type Transformers.

.3 CSA 802 Standard. – Minimum efficiency values for dry type transformer.

.4 NEMA- ST-20.

.5 ANSI 57.12.01 General requirements of dry type distribution & power transformers.

1.3 PRODUCT DATA & SHOP DRAWINGS

.1 Submit product data in accordance with Section 26 05 00. This shall include dimensions, weight, electrical performance %Z, X/R, Inrush current, no load loss, load loss.

1.4 SOURCE QUALITY CONTROL

.1 Submit full production test data per CSA- C9 Standard for each KVA rating to Engineer for review. Units shall not be shipped until this process is complete.

.2 Owner reserves the right to verify test data at site by third party.

2 Products

2.1 TRANSFORMERS

.1 Transformers with primary windings shall have the following characteristics:
  .1 Voltage and kVA ratings as indicated in the Contract Documents.
  .2 Single or three phase as indicated in the Contract Documents.
  .3 Delta connected for three phase transformers as indicated in the Contract Documents.
  .4 1.2 kV insulation class with standard B.I.L.
  .5 Four 2 1/2% taps, 2 FCAN and 2 FCBN.

.2 Transformers with secondary windings shall have the following characteristics:
  .1 Voltage rating as indicated in Contract Documents.
  .2 Wye connected for three phase transformers as indicated on the Drawing.

.3 Provide full width electrostatic shield resulting in a maximum effective coupling capacitance between the primary and secondary of 33 picofarads. The shield shall be located in the windings to increase the electrical noise attenuation. Terminate the shields at an isolated terminal in the terminal connection area.

.4 Transformers shall have the following characteristics:

.1 The transformers shall be K-13 rated transformers.

.2 Transformers shall be specifically designed to supply 100% of the 60hz fundamental rated current, 33% of the fundamental current as third harmonic, 20% of the fundamental current as fifth harmonic, 14% of the fundamental current as seventh harmonic, 11% of the fundamental current as ninth harmonic, and lower proportional percentages of the fundamental current through the 25th harmonic.

.3 Transformers shall be marked with a label stating 'Suitable for Non-Sinusoidal Current Load with K factor not to exceed 13.

.4 Type ANN

.5 Class 220 C insulation. Neither the primary nor the secondary temperature shall exceed the 220°C at any point in the coils while carrying their full load.

.6 115°C temperature rise.

.7 Vacuum impregnated polyester resin construction.

.8 Transformer to be suitable for loads with crest factor up to 4.5 and capable to deliver full nameplate kVA for loads of up to K-factor of 13, without exceeding 115°C temperature rise.

.9 Average sound level: 40dB (up to 9kVA), 45dB (10-15kVA), 50dB (51-150kVA), 55db (151-300kVA), 60db (above 301 kVA).

.10 Standard hipot level.

.11 Impedance: 3% min., 4.5% max. up to & including 112.5 kVA

.1 4% min, 5% max 150 to 225 kVA

.2 5% min, 6% max 300 & 500 kVA

.12 Neutral connection to be rated at twice the ampacity of the secondary phase current.

.13 The 200% neutral ampacity to be established at the star point of the transfer coils and extended through to the neutral connection to the Contractor's field wiring.

.14 CSA enclosure 1, sprinkler proof with removable front cover.

.15 Acid etches the enclosure, prime with zinc chromate primer and apply 2 finish coats of enamel. Transformers on normal power shall be finished with ASA 61 or 49 light grey.

.16 Transformers on emergency or backup power shall be finished with two coats of Sherwin Williams No. F65E37 International Orange.

.17 Paint transformers serving the UPS distribution system shall be finished in two coats of PPG #PCT57215 (Royal Blue).

.18 Manufacturer to provide quart of touch-up paint or several pressurized spray cans to touch-up small marred during installation.

.19 A front accessible terminal compartment at the bottom of the enclosure suitable for 90°C rated conductors (ampacity corresponding to 75°).

.20 Vibration dampers between the frame and the core and coils assembly.

.21 Bolted type off load tap changer.

.22 A nameplate shall be affixed to the enclosure indicating, but not restricted to the following:
- .1 Voltage ratings
- .2 kVA rating
- .3 Impedance
- .4 Type
- .5 Insulation class
- .6 Temperature rise
- .7 Connection diagram
- .8 Serial number.

.23 A minimum efficiency per CSA-802.

.24 A core constructed of laminations of high permeability silicon steel M6 or better grade and visibly grounded to the enclosure by means of a flexible grounding conductor, sized in accordance with applicable standards. It shall be designed with low hysteresis and eddy current losses.

.25 No load excitation currents shall be less than 5% up to 75 kVA and less than 4% above 75 kVA. No load losses cannot exceed 0.36% to 0.4% of nameplate rating.

.26 Windings shall be of high conductivity copper.

.27 Transformer to withstand available short circuit level.

2.2 MANUFACTURERS

.1 Transformers shall be of one Manufacturer. Acceptable manufacturers are:
- .1 Hammond Power Solutions
- .2 Schneider Electric
- .3 Rex Power Magnetics

3 Execution

3.1 MOUNTING

.1 Verify test reports, serial number, and tag identification prior to installation.

.2 The maximum size transformer that is permitted to be suspend mounted is 75 KVA.

.3 Floor mount all dry type transformers over 75 KVA.

.4 Ensure adequate clearance around the transformers for ventilation.

.5 Install the transformers in a level and upright position.

.6 Remove shipping supports only after the transformers have been installed and just before placing them into service.

.7 Loosen the isolation pad bolts until no compression is visible.

.8 Provide vibration mounting pads for all transformers regardless of mounting method.

.9 The vibration isolation for transformers shall not be short-circuited by the installation of any rigid connections, such as taught flexible conduit.

3.2 CONNECTIONS

.1 Make the primary and secondary wiring connections as shown on the Drawings.

.2 Energize the transformers as soon as practicable after installation.

.3 Adjust transformer taps as required to achieve suitable secondary voltage at loads.

3.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification nameplate in accordance with Section 26 05 03.

3.4 SHOP DRAWINGS

.1 Shop drawing for this Section will not be reviewed prior to the short circuit, coordination and arc flash hazard studies being submitted and reviewed by the Consultant.

END OF SECTION

1 General

1.1 REFERENCES AND RELATED WORK

.1 Section 26 05 00
.2 Section 26 24 13
.3 Section 26 24 16
.4 Conform to relevant Sections of Specifications for Division 26 and other Divisions.

1.2 SYSTEM

.1 The Specifications in this Section describe the electrical and mechanical requirements for a protection system provided by high-energy transient voltage surge suppressors.

.2 The specified system shall provide effective, high-energy surge current diversion and be suitable for application in ANSI/IEEE C62.41 Category B environment (as tested by ANSI/IEEE C62).

.3 The Surge Protective Device (SPD) shall consist of a high performance filter designed to provide transient voltage surge suppression and high-frequency electrical noise filtering.

.4 The specified unit shall be compatible with non-linear loads and provide high energy transient voltage suppression, surge current diversion and high-frequency electrical line noise attenuation.

.5 The unit shall be connected in parallel with the electrical distribution system.

.6 The operation of the unit shall not be affected by or interact with any other filter or harmonic reduction device installed on the electrical distribution system.

.7 The SPD unit shall be remote of panelboards and shall be manufactured by the same Manufacturer. The SPD unit shall be connected to the equipment via a circuit breaker from within the equipment in order that the SPD unit can be serviced. The SPD shall be of modular design.

1.3 STANDARDS

.1 The specified system shall be designed, manufactured, tested and installed in compliance with the following codes and standards:
  .1 Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.11, C62.41, C62.45)
  .2 American National Standards Institute.
  .3 Federal Information Processing Standards Publication 94 (FIPS PUB 94).
  .4 National Electrical Manufacturer Association (NEMA LS-1 1992 All Tests).
  .5 MIL Standard 220A Method of Insertion Loss Measurement.
  .6 Underwriters Laboratories UL 1283 and UL 1449 (most recent edition).
  .7 Canadian Standards (CUL).
  .8 Canadian Standards Association (CSA) CSAC22.2-Latest Edition.
  .9 Ontario Hydro Electrical Safety Code Latest Edition.

1.4 PRODUCT SHOP DRAWING DATA

.1 Product data shall be submitted in accordance with Section 26 05 00. This shall include schematic diagram and all options including indicating lights and dry contacts.

.2 Evidence of compliance to the certifications as per CSA and UL 1449 must be submitted. Manufacturer shall submit the NEMA LS-11992 test results. This will show actual test data as certified by UL and ANSI standard. Documentation must include copy of UL Listing Report. Manufacturer shall certify stating that tested product (UL tests) and delivered product both had same suppliers for raw materials and same processes to manufacture.

1.5 SUBMITTALS

.1 Product Data: Provide catalogue sheets showing voltage, physical size, Measured Limited Voltage for each waveform listed, UL1449 latest revision, latest edition, suppressed voltage ratings, dimensions showing construction, lifting and support points, enclosure details, per mode and per phase peak surge current, modes of discrete suppression circuitry, warranty period and replacement terms, conductor size, conductor type and lead length.

.2 Submit product data for all components and accessories.

.3 Manufacturer's Installation Instructions: use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product. Indicate maximum size of circuit breaker or fuse to be connected for each unit.

.4 List and detail all protection systems such as fuses, disconnecting means and protective features.

.5 Provide verification that the SPD device complies with the required UL1449 latest edition, latest revision, and CSA approvals.

.6 Provide actual let through voltage test data in the form of oscillograph results for the ANSI/IEEE C62.41 Category C3 & C1 (combination wave) and A1 (ringwave) tested in accordance with ANSI/IEEE C62.45.

.7 Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 10 khz and 100 khz verifying the devices noise attenuation equals or exceeds 50 db at 100 khz.

.8 Provide test report in compliance with NEMA LS1 from a recognized independent testing laboratory verifying the suppressor components can survive published surge current rating on both per mode and per phase basis using the IEEE C 62.41, 8x20 microsecond current wave. Test data must be on a complete SPD with internal fusing in place. Test data on an individual module is not acceptable.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 The operating temperature range shall be -40° to 70°C (-40° to 160°F).

.2 The unit shall be capable of operation up to 13,000' above sea level.

.3 No appreciable magnetic fields shall be generated. Unit shall be capable of use in computer rooms without danger to data storage systems or devices.

.4 Operation shall be reliable in an environment with 5% to 95% non-condensing relative humidity.

.5 The unit shall not generate any audible noise during normal operation.

1.7 QUALITY ASSURANCE

.1 The Manufacturer shall provide a full 10 year parts and labour warranty from date of shipment against failure when installed in compliance with Manufacturer's written instructions, ULC listing requirements, and any applicable national or local electrical codes. Manufacturer shall make available for consultation, (local, national) engineering service support. Where direct factory employed Service Engineers are not locally available, travel time from the factory or the nearest dispatch centre shall be stated in the Bid form.

.2 An SPD that shows evidence of failure or incorrect operation during the warranty period shall be replaced free of charge. Since "Acts of Nature" or similar statements typically include the threat of lightning to which the SPD's shall be exposed, any such clause limiting warranty responsibility in the general conditions of this Specification shall not apply to this Section. That is, the warranty must specifically provide for unlimited free replacements in the event of failure caused by the effects of lightning and all other electrical anomalies. The warranty shall cover the entire device, not just various components, such as modules only.

.3 The installation of SPD's in or on electrical distribution equipment shall in no way compromise or violate equipment listing, labeling, or warranty of the distribution equipment.

1.8 MANUFACTURERS

.1 Acceptable Manufacturers:
- .1 Schneider Electric
- .2 Eaton
- .3 International Innovative Systems-Total Protection Solutions
- .4 or approved equivalent

1.9 QUALIFICATIONS

.1 The Manufacturer of the assembly shall be the Manufacturer of the major components within the assembly.

.2 For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

.3 The Manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of 5 years. When requested by the Consultant, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

.4 Provide Seismic tested equipment as follows:

.1 The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the International Building Code (IBC) for zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear Manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, IBC: a peak of 2.45g's (3.2-11 Hz), and a ZPA of 0.98g's applied at the base of the equipment.

.1 The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.

.2 The Manufacturer shall certify the equipment based on a detailed computer analysis of the entire assembly structure and its components. Guidelines for the installation consistent with these requirements shall be provided by the switchgear Manufacturer and be based upon testing of representative equipment. The equipment Manufacturer shall document the requirements necessary for proper seismic mounting of the equipment.

.3 The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

.4 The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed Civil Engineer in the state. Mounting recommendations shall be provided by the Manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.

.5 The equipment Manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

.6 The equipment Manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Equipment shall be handled and stored in accordance with Manufacturer's instructions. One copy of Manufacturer's instructions shall be included with the equipment at time of shipment.

1.11 OPERATION AND MAINTENANCE MANUALS

.1 Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

2 Products

2.1 PERFORMANCE

.1 General

.1 The SPD shall be listed by ETL, UL, or other nationally recognized test laboratory to UL's 1283 and UL's 1449 standards (latest edition, latest revision), and not merely the components or modules. All SPD's shall be Type 1 for use in Type 1 and Type 2 locations.

.2 The SPD shall protect all modes L-G, L-N, L-L, and N-G, for WYE systems have discrete suppression circuitry in L-G, L-N and N-G, and have bidirectional, positive and negative impulse protection. Line-to-neutral-to-ground protection is not acceptable where line-to-ground is specified, and accordingly reduced mode units with suppression circuitry built into only 4 modes are not acceptable. For delta systems, the unit shall have discrete suppression circuitry in L-G and L-L.

.3 The maximum continuous operating voltage (MCOV) of all components shall not be less than 125% for a 120V system and 120% for 220 and 240V systems, and 115% for 277 and 480V systems.

.4 All SPD's shall be equipped with a comprehensive monitoring system which shall include a visual LCD panel display providing information on unit status and phase loss/protection loss.

.5 If a disconnect switch is specified, the disconnect switch and the SPD as a system shall be capable of interrupting up to a 200kA symmetrical fault current with 600 VAC applied.

.6 Each design configuration shall have the maximum single pulse surge current capacity per mode verified through testing at an independent, nationally recognized test laboratory not affiliated with the Manufacturer. To be considered for approval, the Manufacturer must submit a test report on a unit which was tested with internal over current fusing in place. The test shall include a 1.2 X 50 µsec 6000V open circuit voltage waveform and an 8 X 20 µsec 500A short circuit current waveform to benchmark the unit's suppression voltage, followed by a single pulse surge of maximum rated surge current magnitude with an approximated 8 X 20 µsec waveform. To complete the test, another identical surge shall be applied to verify the unit's survival. Compliance is achieved if the suppression voltage found from the two impulses do not vary by more than +10%. Test data on an individual module is not acceptable.

.7 SPD shall be separate from panelboard.

.2 SERVICE ENTRANCE PROTECTION – "SWB-A"

.1 The SPD for this location shall be as indicated on project Drawings. SPD shall be separate from panelboard. Integral SPD shall not be acceptable. SPD's shall be certified to UL1283 and UL 1449 Fourth Ed. Type 1 for use in Type 1 or Type 2 locations.

.2 Service entrance panels shall be protected by a 160Ka Total Protection Solutions panel mounted SPD.

.3 The Manufacturer shall provide written specifications showing let-through voltage of the unit with 6" of lead length (at the module or at the lug data is not acceptable as it does not represent true "as installed" performance) pursuant to ANSI/IEEE C62.41.1 and C62.45, 2002, categories B/C and

C-High bi-wave, 90° phase angle, positive polarity, measurements in peak voltage from the zero reference, all dynamic tests except N-G, and UL suppressed voltage ratings, all of which shall be no higher than:

.1 ANSI/IEEE C62.41-2002 Measured Limiting Voltage

B3/C1 Impulse (6kV, 3kA)

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
347/600 (3Y600)	1295V	1295V	2130V	1292V

C-High Impulse (20kV, 10kA)

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
347/600 (3Y600)	1710V	1783V	2893V	1610

UL Voltage Protection Ratings

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
347/600 (3Y600)	1500V	1500V	2500V	1500V

.4 The unit shall have a peak surge current of no less than; 160kA/phase, 80kA/mode, 8 X 20 us waveform, single impulse, independently verified.

.5 Internal Fusing - Overcurrent Protection

.1 Each Metal Oxide Varistor, or other primary suppression component, shall be individually fused for safety and performance to allow the SPD to withstand the full rated single pulse peak surge capacity per mode without the operation or failure of the fuses. Overcurrent fusing that limits the listed peak surge current of the SPD is not acceptable. Replaceable cartridge type per phase or per mode overcurrent fusing is not acceptable where there is more then one MOV per mode.

.2 Fusing shall be present in every mode, including Neutral-to-Ground.

.3 The fusing shall be capable of interrupting up to a 200kA symmetrical fault current with 600VAC applied.

.4 The SPD shall be marked with a Short Circuit Current Rating (SCCR) and shall not be installed at a point on the system where the available fault current is in excess of that rating per the National Electric Code Article 285.

.6 Obtain all surge suppression devices through one source from a single Manufacturer.

.7 No unit will be accepted unless it meets the warranty, strength, safety features, IEEE let-through levels, modes of discrete suppression circuitry, fusing, independent NEMA LS-1 per mode surge testing, and all other requirements of this Specification.

.3 DISTRIBUTION PANEL “PP-AA”

.1 SPD(s) for this location shall be as indicated on project Drawings. SPD shall be separate from panelboard. Integral SPD shall not be acceptable. SPD’s shall be certified to UL 60384-14 (formerly UL 1283), and UL1449 Fourth Ed. Type 1 or 2 for use in Type 1 and Type 2 locations.

.2 The Manufacturer shall provide written specifications showing let-through voltage of the unit with 6” of lead length (at the module or at the lug data is not acceptable as it does not represent true "as installed" performance) pursuant to ANSI/IEEE C62.41.1 and C62.45, 2002, categories B/C and C-High bi-wave, 90° phase angle, positive polarity, measurements in

peak voltage from the zero reference, all dynamic tests except N-G, and UL suppressed voltage ratings, all of which shall be no higher than:

.1 ANSI/IEEE C62.41-2002 Measured Limiting Voltage

B3/C1 Impulse (6kV, 3kA)

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
347/600 (3Y600)	1295V	1295V	2130V	1292V

C3 Impulse (20kV, 10kA)

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
347/600 (3Y600)	1710V	1783V	2893V	1610V

UL Voltage Protection Ratings

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
347/600 (3Y480)	1500V	1500V	2500V	1500V

.3 The unit shall have a peak surge current of no less than 120kA/phase, 60kA/mode, 8 X 20 us waveform, single impulse, verified by third party test reports.

.4 Internal Fusing - Overcurrent Protection

.1 Each Metal Oxide Varistor, or other primary suppression component, shall be individually fused for safety and performance to allow the SPD to withstand the full rated single pulse peak surge capacity per mode without the operation or failure of the fuses. Overcurrent fusing that limits the listed peak surge current of the SPD is not acceptable. Replaceable cartridge type per phase or per mode overcurrent fusing is not acceptable where there is more then one MOV per mode.

.2 Fusing shall be present in every mode, including Neutral-to-Ground.

.3 The fusing shall be capable of interrupting up to a 200kA symmetrical fault current with 600VAC applied.

.4 The SPD shall be marked with a Short Circuit Current Rating (SCCR) and shall not be installed at a point on the system where the available fault current is in excess of that rating per the National Electric Code Article 285.

.5 Obtain all surge suppression devices through one source from a single Manufacturer.

.6 No unit will be accepted unless it meets the warranty, strength, safety features, IEEE let-through levels, modes of discrete suppression circuitry, fusing, independent NEMA LS-1 per mode surge testing, and all other requirements of this Specification.

.4 SUBPANELS “PP-D” AND “PP-F”

.1 SPD(s) for this location shall be as indicated on project Drawings. SPD shall be separate from panelboard. Integral SPD shall not be acceptable. SPD’s shall be certified to UL 60384-14 (formerly UL1283), and UL1449 Fourth Ed. Type 1 or 2 for use in Type 1 and Type 2 locations.

.2 The Manufacturer shall provide written specifications showing let-through voltage of the unit with 6” of lead length (at the module or at the lug data is not acceptable as it does not represent true "as installed" performance) pursuant to ANSI/IEEE C62.41.1 and C62.45, 1991, categories A1 & A3 ring wave, 180° phase angle, category B3 Ringwave, and UL suppressed voltage ratings, 90° phase angle, positive polarity, measurements in peak

voltage from the zero reference, all dynamic tests except N-G, which shall be no higher than:

.1 ANSI/IEEE C62.41-1991 Measured Limiting Voltage

A1 Ring Wave (2kV, 67A)	Tested at 180° phase angle				
Voltage (Voltage Code)		L-N	L-G	L-L	N-G
120/208 (3Y208)	29V	46V	39V	40V	
A3 Ring Wave (6kV, 200A)	Tested at 180° phase angle				
Voltage (Voltage Code)		L-N	L-G	L-L	N-G
120/208 (3Y208)	56V	81V	88V	112V	
B3 Ring Wave (6kV, 500A)	Tested at 90° phase angle				
Voltage (Voltage Code)		L-N	L-G	L-L	N-G
120/208 (3Y208)	437V	592V	612V	324V	
UL Voltage Protection Ratings					
Voltage (Voltage Code)		L-N	L-G	L-L	N-G
120/208 (3Y208)	700V	700V	1000V	700V	

.3 The unit shall have a peak surge current of no less than 120kA/phase, 60kA/mode, 8 X 20 us waveform, single impulse, verified by third party test reports.

.4 Internal Fusing - Overcurrent Protection

.1 Each Metal Oxide Varistor, or other primary suppression component, shall be individually fused for safety and performance to allow the SPD to withstand the full rated single pulse peak surge capacity per mode without the operation or failure of the fuses. Overcurrent fusing that limits the listed peak surge current of the SPD is not acceptable. Replaceable cartridge type per phase or per mode overcurrent fusing is not acceptable where there is more then one MOV per mode.

.2 Fusing shall be present in every mode, including Neutral-to-Ground.

.3 The fusing shall be capable of interrupting up to a 200kA symmetrical fault current with 600VAC applied.

.4 The SPD shall be marked with a Short Circuit Current Rating (SCCR) and shall not be installed at a point on the system where the available fault current is in excess of that rating per the National Electric Code Article 285.

.5 The SPD shall be capable of attenuating internally generated ringing type transients and noise and shall have an enhanced transient filter supported by a specification sheet which lists the IEEE A1 Ring Wave let-through levels no higher than those set forth above.

.6 Because of space limitation, the enclosure shall not exceed 4.0” D x 4.0” W x 10.3” H to allow close-to-the load installation on flush mount panels and between adjacent panelboard**.** For recessed panels, a flush mount cover plate shall be provided with each unit, for new construction a Flush Mount Kit Accessory shall be provided.

.7 Obtain all surge suppression devices through one source from a single Manufacturer.

.8 No unit will be accepted unless it meets the warranty, strength, safety features, IEEE let-through levels, modes of discrete suppression circuitry,

fusing, independent NEMA LS-1 per mode surge testing, and all other requirements of this Specification.

.5 SPD Design

.1 Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV.
Designs incorporating SPD modules shall not be acceptable.

.2 Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB at 100 kHz using the MIL-STD-220A insertion loss test method. Products not able to demonstrate noise attenuation of 50 dB @ 100 kHz shall be rejected.

.3 Extended Range Filter –The Surge Protective Device shall have a High Frequency Extended Range Tracking filter in each Line to Neutral mode with compliance to UL 1283 and NEMA LS1. The filter shall have published high frequency attenuation rating in the attenuation frequencies.

Attenuation Frequency	50 kHz	100 kHz	500 kHz	1 MHz	10 MHz	100 MHz
Insertion Loss (ratio)	40	316	316	89	200	79
Insertion Loss (dB)	32	50	50	39	46	38

.4 Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.

.5 Monitoring Diagnostics – Each SPD shall provide integral monitoring options:

.6 Each unit shall provide a green / red solid-state indicator light shall be provided on each phase. The absence of a green light and the presence of a red light, shall indicate which phase(s) have been damaged.

.7 Remote Status Monitor – The SPD device must include Form C dry contacts (one normally opened, and one normally closed for remote annunciation of unit status. The remote alarm shall change state if any of the three phases detect a fault condition.

.8 Audible Alarm – The SPD shall provide an audible alarm with a reset pushbutton that will be activated under any fault condition.

.9 Push to Test – The SPD shall be equipped with push-to-test feature designed to provide users with real time testing of the suppressor’s monitoring and diagnostic system. A test button shall be provided to initiate a self test procedure. If the system is fully operational, the self test will activate all indicator lights.

.10 Event Counter – The SPD shall be equipped with an LCD display system designed to indicate to the user how many surges, sags, swells and outages have occurred at the location. The events counter triggers each time under each respective category after significant event occurs. A

reset pushbutton shall also be standard allowing all counters to be zeroed.

.11 Overcurrent Protection Fusing: In order to isolate the SPD under any fault condition, the Manufacturer shall provide:

.12 Individual Fusing: MOVs shall be individually fused via Copper Fuse Trace. The Copper Fuse shall allow protection during high surge (kA) events.

.13 Thermal Protection: MOVs shall be equipped with Thermal Fuse Spring (TFS) Technology which allows disconnection of the suppression component at the overheated stage common during temporary over voltage condition. For small fault currents between 100 mA to 30 Amp, or if the occurrence is over a longer period of time, the TFS will disconnect first. Manufacturers that utilize fuse trace only shall not be approved since there is no fault current protection between 100 mA to 30 A.

.14 All overcurrent protection components shall be tested in compliance with UL 1449-Limited Current Test and AIC rating test.

.15 The minimum repetitive surge current capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 1992 shall be:

.1 Branch Location Panelboard: 9000 impulse per mode.

2.2 SYSTEM APPLICATION

.1 The branch panel located SPD shall be tested and demonstrate to be suitable for ANSI/IEEE C62.41 Category C1 environments.

.2 Surge Current Capacity - The minimum total surge current 8 x 20 microsecond waveform that the device is capable of withstanding shall be as shown in the following table:

Minimum total surge current and withstand capability with compliance to ANSI/IEEE C62.41 & NEMA LS1

Application	Per Phase	Per Mode	Surge Withstand Capabilities ANSI/IEEE C3 Wave (10 kA)
Service Entrance (Switchboard) Distribution	250 kA	125 kA	
Panelboards	160 kA	80 kA	
Branch Locations (Panelboards)	120 kA	60 kA	9000

.3 The complete panelboard including the SPD shall be UL67 listed.

.4 Retrofit Installation (externally mounted suppressor). Maximum conductor lead length between breaker and suppressor shall not exceed 14”. Comply with the Manufacturer’s recommended installation and wiring practices.

3 Execution

3.1 EXAMINATION

.1 Factory Testing

.1 Standard factory tests shall be performed on the equipment under this Section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.2 INSTALLATION

.1 The SPD shall be remote mounted to the Panelboard and shall be installed by the Contractor. Connect SPD units to circuit breaker within the equipment noted on Drawings. Conductors are to be as short and straight as possible as, no greater than 18” in length. Input conductors to the SPD/filter shall be twisted to reduce impedance during high frequency filtering. Cable size shall be minimum #6 AWG.

.2 The SPD should be installed following the Manufacturer's recommended practices and in compliance with all applicable codes.

.3 The entire SPD installation must be inspected by an authorized Manufacturer’s representative and supply certificate of completion. This cost shall be included in the tender price. Indicate provision for this inspection on shop drawing submission.

.4 Contractor will ensure the dry relay contacts on the inside of Service Track cover on main services are connected to alarm system to indicate when replacement is required.

3.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification nameplate in accordance with Section 26 05 03.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 05 21
.3 Section 26 24 13
.4 Section 33 71 49
.5 Conform to relevant Sections of Specification for this and other Divisions.

1.2 SERVICE CHARACTERISTICS

.1 The Power Authority feeds the site from overhead pole at 13.8kV, 3-phase, 3-wire, un-grounded.

1.3 SERVICE ENTRANCE

.1 In accordance with 26 05 44 underground duct bank must be provided between the properly line and the power authority pole by the Contractor.

.2 500kVA 13.8kV: 600/347V 3P 4W Transformer will be provided by Power Authority. Installation, testing and commissioning will be completed by Contractor. Contractor to follow Contract Drawings and power authority specifications/drawings for installation of transformer, vault, grounding, duct banks, concrete pad and bollards.

.3 Contractor to follow the power authority service plan, Contract Documents including Drawings for the scope of work.

1.4 SUBMISSION

.1 Submit to the required Power Authority all Drawings and information they require including electrical, mechanical, structural and architectural Drawings pertaining to the service entrance switchboard and site plan.

.2 Submit to the required Power Authority the main 600/347V 600A 3P 4W switchboard shop drawings showing in detail all metering arrangements and connection points for service.

1.5 APPROVALS

.1 Obtain approval from the Power Authority for installation prior to proceeding with the work.

.2 Advise the Power Authority in ample time, of the progress of the work to ensure that the construction schedule is coordinated with them and all other trades.

.3 Apply to the Power Authority construction department 48 hours prior to excavating the primary duct bank trenches and pouring concrete.

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

SECONDARY SWITCHBOARD

1 General

1.1 WORK INCLUDED

.1 Provide the main distribution switchboard and all equipment contained therein suitable for use on a 600 volt, 3 phase, 4 wire grounded neutral system and arranged in Sections as shown on the Drawings.

1.2 RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 05 03
.3 Section 26 05 10
.4 Section 26 05 28
.5 Section 26 22 18
.6 Section 26 28 21
.7 Conform to relevant Sections of Specification for this and other Divisions.

1.3 SHOP DRAWINGS & PRODUCT DATA

.1 Submit shop drawings in accordance with Section 26 05 00.

.2 Indicate on shop drawings:
- .1 Site installation details, including close coupling with power transformer.
- .2 Floor anchoring method and foundation template.
- .3 Dimensioned feeders' entry and exit locations.
- .4 Dimensioned position and size of bus.
- .5 Overall length, height and depth of complete switchboard.
- .6 Dimensioned layout of internal and front panel mounted components.
- .7 Product data for all components and devices: main circuit breaker, distribution circuit breakers, digital metering system, metering equipment's, SPD, etc.

1.4 APPROVED MANUFACTURERS

.1 Schneider Electric

.2 Eaton Canada

.3 Siemens Canada

.4 All Secondary Switchboards (26 24 13), Distribution Panels (26 24 16), Panelboards Breaker Type (26 24 17) shall be of the same Manufacturer.

2 Products

2.1 CONSTRUCTION

.1 Standard cells of minimum 12 gauge sheet steel reinforced where necessary.

.2 Ventilation, and panels or doors on the front and rear of the assembly.

.3 Channel base along the entire length of each switchboard assembly.

.4 All bus bars, joints and connections of tinned copper and rated for current carrying capacity, as indicated and short circuit bracing of 42kA symmetrical. Design buses, joints and connections so that maximum temperature rise of any part of the switchboard will not exceed 50°C over an ambient temperature of 40°C.

.5 A full length bare ground bus solidly bolted to the steel assembly with a momentary current-rating equal to or greater than the momentary rating of any of the apparatus in the assembly, and at least of 7mm x 50mm (1/4" x 2") size.

.6 A full capacity neutral insulated from the switchboard enclosure and run the full length of the board.

.7 A plastic lamacoid type mimic bus on switchboard, colour to be selected, installed with adhesive.

.8 Outgoing low voltage feeder cable terminations with compression type lugs, size and type to suit cable size and conductor material.

.9 Hot dip galvanize the switchboard tubs after fabrication or acid etch, prime and apply two finish coats.

.10 Switchboards and distribution boards on normal power shall be finished with two coats of air dried ASA 61 or ASA 49 grey enamel to the switchboard tubs. Finish shall be over sprayed.

.11 Switchboards and distribution boards on emergency or backup power shall be finished with two coats of Sherwin Williams No. F65E37 International Orange. Finish shall be over sprayed.

.12 Switchboards and distribution board serving the UPS distribution system shall be finished in two coats of PPG #PCT57215 (Royal Blue). Finish shall be over sprayed.

.13 Enclosure shall be sprinkler proof for indoor application and weather proof, c/w necessary environment control devices, for outdoor application.

.14 Interrupting Capacity of 42kA symmetrical minimum.

2.2 MAIN CIRCUIT BREAKER

.1 Main Breakers: Section 26 28 21 – Moulded Case Circuit Breakers

.2 Provide breakers as specified.

2.3 DISTRIBUTION CIRCUIT BREAKERS

.1 Breakers: Section 26 28 21 as indicated.

.2 Provide breakers as specified.

.3 All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.

2.4 INSTRUMENT TRANSFORMERS

.1 Provide Potential transformers: to CAN3-C13, dry type for indoor use, with following characteristics:

.1 Nominal voltage class 600 V.
.2 Rated frequency: 60 Hz.
.3 Basic impulse level: 10 kV.
.4 Voltage ratio: 5:1 (600/120V)
.5 Accuracy rating: 0.6W, 1.2X (3%).
.6 Potential transformers equipped with fuse holder and fuses.

.2 Provide Current transformers: to CAN3-C13, dry type for indoor use with following characteristics:
.1 Nominal voltage class: 600 V.
.2 Rated frequency: 60 Hz.
.3 Basic impulse level: 10 kV.
.4 Metering accuracy rating: 0.3 through B0.2 (3%).
.5 Relay accuracy rating: C100.
.6 Rated primary and secondary current: as shown indicated.
.7 Continuous-current rating factor: 1.5 at 55°C.

.3 Positive action automatic short-circuiting device in secondary terminals.

.4 Short -time mechanical current rating - 20 times primary rating.

.5 Short -time thermal current rating - 20 times primary rating.

3 Execution

3.1 INSTALLATION

.1 Visually inspect switchboard for evidence of damage and verify that surfaces are ready to get all the units.

.2 Visually inspect all the items and accessories in accordance with Specifications and Drawings.

.3 Verify field measurements and ensure that they match the shop drawings.

.4 Verify that required utilities (control voltage, heaters, etc.) are available and they are operational.

.5 Locate secondary switchboard equipment and secure to floor.

.6 Re-make sections which had been separated for shipping purposes.

.7 Connect main incoming busduct & cable to the line side of main L.V. switchboard. Ensure that phase collection of busbars takes place within switchboard.

.8 Connect load terminals of distribution section devices. Bending of cables should be avoided or minimized. Cable radii should not exceed those specified by cable Manufacturer.

.9 Check factory made connections for mechanical security and electrical continuity.

.10 Run a minimum of 4/0 AWG bare copper grounding conductor in 25mm (1") conduit from ground bus to building ground.

.11 Provide a rubber ground mat for the full length of the switchboard, both front and rear.

.12 Provide all tags and nameplates as required per CEC, OESC and these Specifications.

.13 Follow NETA ATS-2006 specification for complete record keeping.

.14 Test and verify mechanical key interlock system.

.15 Verify megger tests on all devices, equipment, and provide record of test to Consultants and Owner for information. This will be included in the manual.

.16 Verify that the time current curves of the associated main and secondary protective devices have their characteristic curves set to match the approved curves of the project short circuit, system co-ordination & arc flash study.

.17 Main switchboard shall be installed on indoor housekeeping pad.

END OF SECTION

DISTRIBUTION PANEL

1 General

1.1 REFERENCES AND RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 05 10
.3 Section 26 05 29
.4 Section 26 28 21
.5 Conform to relevant Sections of the Specifications for Division 26 and all other Divisions.

1.2 GENERAL

.1 Provide engraved nameplates on each fused switch in accordance with details specified in Section 26 05 03.

1.3 STANDARDS

.1 Panels shall be constructed in accordance with latest edition of following standards:

.2 CSA Standard C22.2 No. 29-M1989 – Panelboards and Enclosed Panelboards.

.3 CSA Standard C22.2 No. 94 – M91 – Special Purpose Enclosures.

.4 CSA Standard C22.2 No. 5-M91 – Molded Case Circuit Breakers.

.5 CSA Standard C22.2 No. 4 – Enclosed Switches.

.6 Federal Specification W-P-115C – Type I Class 1.

.7 Federal Specification W-C-375B/Gen – Circuit Breakers, Molded Case, Branch Circuit and Service.

.8 Federal Specification W-C-865C – Fusible Switches.

.9 NFPA 70 – National Electrical Code (NEC).

.10 ASTM – American Society of Testing Materials.

.11 Seismic requirements of Ontario Building Code Latest Edition.

.12 C22.1-02 – Canadian Electrical Code Latest Edition.

.13 Ontario Electrical Safety Code Latest Edition.

2 Products

2.1 GENERAL

.1 Distribution panels shall be surface or flush-mounted type as shown on the Drawings.

.2 Panels shall be of steel construction, without overall doors, unless shown otherwise on the Drawings.

.3 Panels shall be given a rust-resistant treatment to both tub and trim.

.4 Flush panels shall be standard CSA 1 enclosures; surface mounted panels shall be sprinkler-proof.

.5 Flush panels shall have concealed hinges and flush type combination lock latch. Doors shall open minimum 135°. Trims shall have fasteners concealed and shall be prime coated to receive room finish paint.

.6 Surface mounted panels shall have Manufacturer's standard trim complete with lock and latch.

.7 Surface mounted panel shall be sprinkler proof.

.8 Panel locks shall be common to one key throughout project.

.9 Branch circuits shown with breakers shall be rated for appropriate short circuit rating.

.10 Circuit breakers requiring shunt trip coils shall be as per Drawing. Ensure that the terminals for connecting power to shunt trip units are easily accessible in control compartment with marked terminal block. These details shall also appear on the shop drawings.

.11 Panels shall have mains capacity and branch switches as shown. Buswork in panels shall be copper throughout.

.12 Panel bus and switch units shall be designed to safely withstand mechanical stresses and heating imposed by minimum symmetrical fault current indicated in the Contract Documents.

.13 Panel interiors shall be factory assembled. They shall be designed so that units are readily removable and interchangeable without modification to buswork or mounting rails.

.14 Panels shall be complete with fused provisions as shown. "Spares" shall be understood to be complete breakers/fuse switches less fuses. Provisions shall be understood to include necessary buswork such that Owners, at a later date, need buy fused switch only.

.15 Panels shall be complete with breaker sections, spares and spaces as shown on the Drawings. "Spares" shall be understood to be complete breaker. "Spaces" shall include necessary buswork in order to allow for additional future breaker without the need for any buswork.

.16 Panels shall be sectionalized so that flush panels do not exceed 72” and surface mounted panels do not exceed 90" in height, unless noted otherwise in the Contract Documents. Multi-section panels shall have main cross-over solid bus bars. Main bus capacity of each section shall be full size to match cross-over bus. Buswork in panels shall be copper. All phase and neutral busbars shall have same rating.

.17 Fuse units shall be designed for CSA HRCI-J fuses.

.18 Panels on normal power shall be finished with two coats of air dried ASA 61 or ASA 49 grey enamel to the panelboard tubs. Finish shall be over sprayed.

.19 Panels on emergency power shall be finished with two coats of Signal Red MG0017 or approved equal. Finish shall be over sprayed.

.20 Panels’ backup power shall be finished with two coats of Sherwin Williams No. F65E37 International Orange, approved equal. Finish shall be over sprayed.

.21 Panels serving the UPS distribution system shall be finished in two coats of PPG Pittsburgh Paints #PCT57215(Royal Blue) or approved equal. Finish shall be over sprayed.

.22 Interrupting capacity shall be 42 kA (symmetrical) or as indicated in the Contract Documents.

2.2 CIRCUIT BREAKER DISTRIBUTION PANELBOARD

.1 Interior

.1 Shall be rated 600 VAC or 250 VDC maximum. Continuous main current ratings as indicated on associated Drawings not to exceed 225 amperes maximum. Bussing shall be fully tested to meet the CSA C22.2 No. 29 standard for temperature rise and short circuit.

.2 Interiors shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.

.3 Provide CSA/ULC listed short circuit current ratings (SCCR) as indicated on the associated Drawings.

.4 The bussing shall be fully rated with sequentially phased branch distribution. All panelboard bussing shall be silver plated copper. Bus bar plating shall run the entire length of the bus bar.

.5 Interior trim shall be of dead-front construction to shield user from all energized parts.

.6 A solidly bonded copper equipment ground bar shall be provided. Additional copper isolated/insulated ground bar shall also be provided if indicated in the Contract Documents.

.7 Solid neutral shall be designed to meet Canadian requirements per CSA C22.2 No. 4 & 29. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection. Gutter-mounted neutral will not be acceptable; except for Main breaker CSA Service Entrance rated panelboards.

.8 Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, CSA or CUL listed label, and Short Circuit Current Rating shall be displayed on the interior or in a booklet format. Leveling provisions shall be provided for flush mounted applications.

.9 Main breakers can be either vertically mounted or backfed mounted in a branch position.

.2 Group mounted circuit breakers through 225A.

.1 Breakers and all components shall be designed, manufactured and tested in accordance with all applicable ULC and CSA standards.

.2 Circuit breakers(s) shall have interrupting capacity as shown on Drawings. Two tier CSA or ULC listed integrated series equipment ratings are acceptable only when indicated on Drawings that such application is permitted. When series ratings are applied with integral or remote upstream devices, a label or manual shall be provided showing the CSA or ULC approved series ratings including:

.1 Voltage

.2 Size and type of upstream fuses or breakers.

.3 Size and type of branch devices that can be used.

.3 Circuit breaker(s) shall be group mounted Bolt-on with mechanical restraint on a common pan or rail assembly.

.4 All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.

2.3 FUSIBLE DISTRIBUTION PANELBOARD

.1 Interior

.1 Shall be rated for 600 VAC or 250 VDC. Continuous main current ratings are indicated on associated Drawings, not to exceed 225 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with CSA C22.2 No 29 or UL 67.

.2 Short circuit current ratings shall be provided as indicated on the associated Drawings. Main switch and main lug panelboards shall be suitable for use as Service Equipment when application requirements comply with CSA and CEC.

.3 The panelboard bus material shall be plated copper. Bus bar plating shall run the entire length of the bus bar. The bussing shall be fully rated allowing high ampacity switches to be mounted in any position throughout the interior.

.4 A solidly bonded copper equipment ground bar shall be provided. An additional copper isolated/insulated ground bar shall also be provided if indicated on Drawings.

.5 Solid neutral shall be equipped with a full capacity bonding strap for service entrance applications. Gutter mounted solid neutral will not be acceptable.

.6 Nameplates shall contain system information and catalog number or factory order number.

.2 Fusible Switches

.1 The operating mechanism shall be spring driven, with quick-make, quick-break action. Operating handles shall be flange mounted, as an integral part in the operating mechanism. Switch contact shall be knife-blade and jaw construction. Switch shall include visible blades as a visual verification of blade position. There shall be a visible air gap between the switch jaws and the knife-blade with the switch in the OFF (open) position.

.2 Switches shall be secured to the bus with spring reinforced jaw assemblies or bolted securely to the bus using connector assembly.

.3 Fusible switch units shall be equipped with all required mounting brackets and guides.

.4 Switch shall be mechanically interlocked to prevent the opening of the cover when the switch is in the ON position. The cover interlock shall also prevent the switch from being turned ON with the cover open. A manual interlock override shall be provided for testing purposes. Switch cover shall include a hasp by which the cover can be padlocked in the closed position. The operating handle shall have lock-off means with provisions for three .375” padlocks.

.5 There shall be two forms of visible ON/OFF indication: A dual-color operating handle and an ON/OFF nameplate with international markings. The universal nameplate shall be readable regardless of the switch orientation. Each nameplate shall include an easily removable circuit directory card.

.6 Switch fuse clips shall accept Class J fuses through 600 amperes and Class L from 601 amperes through 800 amperes. Fusible switches shall have built-in fuse pullers on 30 through 100 ampere switches as standard construction. Fuse pullers shall disengage the line side of fuse only.

2.4 MANUFACTURERS

.1 Schneider Electric

.2 Eaton Canada

.3 Siemens Canada

.4 All Secondary Switchboards (26 24 13), Distribution Panels (26 24 16), Panelboards Breaker Type (26 24 17) shall be of the same Manufacturer.

3 Execution

3.1 GENERAL

.1 Provide surface or flush-mounting distribution panel as shown on the Drawings.

.2 Mount tops of panels 72” or 90” above floor as applicable.

.3 Panels shall be rigidly supported and shall be square with building lines.

.4 Flush-mounted distribution panels shall be fitted with two - 2” empty conduits from the tub to an accessible location in the ceiling space above the panel.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 05 03
.3 Section 26 05 10
.4 Section 26 05 29
.5 Section 26 28 21
.6 Appendix A - Panel Schedules
.7 Conform to relevant Sections of the Specifications for Division 26 and all other Divisions.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 26 05 00.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

2 Products

2.1 PANELBOARDS

.1 Panelboards: product of one Manufacturer.

.2 Install circuit breakers in panelboards before shipment.

.3 For 250 V panelboards, the bus, the main breaker and the branch breakers must be rated for a minimum of 10,000 A (symmetrical) interrupting capacity except as otherwise indicated in the Contract Documents.

.4 For 600 V panelboards, the bus, the main breaker and the branch breakers must be rated for a minimum of 14,000 A (symmetrical) interrupting capacity except as otherwise indicated in the Contract Documents.

.5 Provide a full size neutral. Provide neutral with 200% the rating of mains, where indicated in the Contract Documents.

.6 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.7 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated in the Contract Documents.

.8 Two keys for each panelboard and key panelboards alike.

.9 Copper bus with neutral of same ampere rating as mains, unless indicated otherwise in the Contract Documents.

.10 Mains: suitable for bolt-on breakers.

.11 Trim with concealed front bolts and hinges.

.12 Trim and door finish specified in Section 26 05 00.

.13 Enclosure shall be sprinkler-proof painted for indoor applications.

.14 Enclosure shall be weatherproof for outdoor applications.

.15 Hot dip galvanized the panelboard tubs after fabrication or acid etch, prime and apply two finish coats.

.16 Panelboards on normal power shall be finished with two coats of air dried ASA 61 or ASA 49 grey enamel to the panelboard tubs. Finish shall be over sprayed.

.17 Panelboards on emergency power shall be finished with two coats of Signal Red MG0017 or approved equal. Finish shall be over sprayed.

.18 Panelboards backup power shall be finished with two coats of Sherwin Williams No. F65E37 International Orange, approved equal. Finish shall be over sprayed.

.19 Panelboards serving the UPS distribution system shall be finished in two coats of PPG Pittsburgh Paints #PCT57215(Royal Blue), or approved equal. Finish shall be over sprayed.

.20 Provide doors with concealed hinges, locks and hardware for all panelboards.

2.2 CUSTOM BUILT PANELBOARD ASSEMBLIES

.1 Provide custom fabricated replacement trims and doors for existing panels, as indicated on Drawings.

.2 Replacement trim and door assembly shall be NEMA-4X type, and shall be coordinated with the architectural Division to suit any modifications to the wall construction and/or finishes.

2.3 BREAKERS

.1 Breakers: to Section 26 28 21.

.2 Provide breakers as specified in the Contract Documents. .

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-on devices for fire alarm, emergency, door supervisory, intercom, snow melting pipe tracing, stairway, exit and night light circuits.

2.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Nameplate for each panelboard.

.3 Nameplate for each circuit in distribution panelboards.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.5 ACCEPTABLE MANUFACTURERS

.1 Schneider Electric

.2 Eaton Canada

.3 Siemens Canada

.4 All Secondary Switchboards (26 24 13), Distribution Panels (26 24 16), Panelboards Breaker Type (26 24 17) shall be of the same Manufacturer.

3 Execution

3.1 INSTALLATION

.1 Locate panelboards as indicated in the Contract Documents and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on block walls or plywood backboards. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 00 or as indicated.

.4 Field-measure all existing panels and fabricate customized components to suit. Any and/or all work may take place during evenings and/or weekends and shall suit the Owner's schedule. No additional charges shall be incurred by the Owner for work required to take place during shutdowns Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus, with respective neutral identified.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 00
.2 Conform to relevant Sections of Specification for this and other Divisions.

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

.2 Product data: Catalog cuts of specified devices upon request as well as field samples (see Quality Assurance “D”)

.3 Samples: Samples of specified devices upon request.

1.3 SUMMARY

.1 Section includes Wiring devices and plates: Types of wiring devices are as follows:
  .1 Ground Fault Circuit Interrupters
  .2 Decorative Style Devices
  .3 Twist – Lock devices
  .4 Wall plates

2 Products

2.1 QUALITY ASSURANCE

.1 Equipment and materials of type for which there are Underwriters Laboratories standard requirements, CSA Certified, listing and labels, shall be listed and labeled by Underwriters Laboratories.

.2 Where equipment and materials have industry certification, labeling or standards (i.e., NEMA – National Electrical Manufacturers Association), this equipment shall be labeled as certified, or comply with standards.

.3 Material and equipment shall be new and conform to grade, quality and standards specified. Equipment or materials of the same type shall be the product of same Manufacturer throughout.

.4 The Manufacturer’s catalog numbers specified represented the minimum standards required.

2.2 WIRING DEVICES – COMMERCIAL AREAS

.1 General:
  .1 Commercial grad wiring devices shall be installed in all areas.

.2 GFCI Receptacle:
  .1 GFCI receptacles shall be cUL Listed and CSA Certified. Meet cUL943 performance requirements.
  .2 GFCI receptacles shall have recessed test and reset buttons to avoid accidental tripping from oversized molded plugs.

.3 Contacts shall be reinforced to assure maximum plug retention.
.4 Large, combination back and side wire terminals to accept up to #10 Wires.
.5 GFCI receptacles shall have LED Indicator Light which will flash red to indicate when device no longer has GFCI protection.
.6 Receptacles shall be Hubbell Canada LP 15A (GF15LA), 20A (GF20LA)

.3 Receptacles Decorative Series Spec Grade:
.1 Receptacles shall represent high quality performance.
.2 Receptacles shall be rated for 15 or 20 amperes as indicated on Drawings.
.3 Receptacles shall be back, and side wired, Decorator style, provide green base ground screw terminal, automatic ground clip, fully enclosed in a nylon face, and have wrap around steel bridge for installation strength, and high heat base.
.4 In general, all receptacles shall be of ampere, voltage and type as indicated on Drawings or herein specified. The following listings and catalog numbers are for type and quality guideline:
.1 Receptacle shall be Hubbell Inc. 15A HBL2152, 20A HBL2162 series.

.4 Switches Decorative Spec Grade:
.1 Switches shall be 15A or 20A rated and must have “framed” outline body to fit stylized plate.
.2 Switches shall have heat resistant thermoset base and 100% copper contact arm and nylon face.
.3 15A Hubbell Type Single Pole HBL2101, 3 WAY HBL2103, 4 WAY HBL2104.
.4 20A Hubbell Type Single Pole HBL2121, 3 WAY HBL2123, 4 WAY HBL2124.

.5 Isolated Ground Receptacles:
.1 Straight blade isolated ground receptacles, 15- or 20-amp 125-volt service shall have isolation method as an integral part of the device. Shall have nylon insulating barrier between grounding contacts and receptacle mounting strap.
.2 All isolated ground receptacles (straight blade and twist lock) shall have impact resistant thermoplastic face and dimensionally stable base.
.3 All isolated ground receptacles are required to have an orange triangle located on the face of the device. If the receptacle face is orange, a black triangle outline is required.
.4 Provide isolated ground receptacles rated 15-amp 125-volt NEMA 5-15R configuration and manufactured by Hubbell Inc., type IG2152.

.6 Surge Suppression Receptacles:
.1 Shall have 4 series parallel 150V (MOVs) and provide 210 joules of transient voltage suppression in all modes, i.e., Normal & Common.
.2 Shall have visual and audible surge status indicators to alert user to surge suppression circuit condition. Visual indicator will be illuminated (red) when power is on, and surge suppression circuit is fully functional. Visual indicator will not be illuminated when power is off. Visual indicator will be flashing when surge suppression circuit has been damaged. Audible

indicator will be silent when surge suppression circuit is fully functional. Audible indicator will sound a constant alarm if surge suppression circuit has been damaged and can be silenced with muting screw feature on device face. (Audible alarm feature not available on all models.)

.3 A line voltage rated fuse, specially calibrated to disconnect the surge suppression circuit in the event of catastrophic failure shall be used.

.4 Provide receptacles which shall be rated 15 ampere 125 Volt with NEMA 5-15R configuration and manufactured by Hubbell Inc., type HBL5262S or approved equal.

.7 Twist – Lock Receptacles:

.1 The approved manufacturer is Hubbell, Inc. or approved equal if they meet the design parameters set forth:

.1 NEMA Twist – Lock Receptacles.

.2 Face (top) shall be nylon with boss diameter of 1.56” on both 20 and 30 amp receptacles.

.3 Face shall also have identifying colour coding feature (colour coding in accordance to IEC 309 standard) by voltage rating to assure proper mating of devices.

.4 Terminal screws shall be #10 silicone bronze and accommodate back or side wiring. 20-amp receptacle terminal shall be capable of accepting #8 AWG wire and provide wire restraint non-loosening design.

.5 Base shall be constructed of dimensionally stable, heat resistant material.

.6 Contact arm shall be one – piece (no riveted assembly) and shall also provide oxide cutting feature for termination integrity.

Twist – Lock
30 Ampere Devices

CATALOG NUMBERS

Rating Body	Voltage	NEMA	Receptacle	Male Plug	Connection
2 Pole 3 wire	125 250	L5-30 L6-30	HBL2610 HBL2620	HBL2611 HBL2621	HBL2613 HBL2623
3 Pole 3 wire	125/250V AC 3Ø250V AC 3Ø480V AC 3Ø600V	L14-30 L15-30 L16-30 L17-30	HBL2710 HBL2720 HBL2730 HBL2740	HBL2711 HBL2721 HBL2731 HBL2741	HBL2713 HBL2723 HBL2733 HBL2743
3 Pole 4 wire	3ØY120 / 208V AV	L21-30	HBL2810	HBL2811	HBL2813

Twist – Lock 20 Ampere Devices CATALOG NUMBERS					
Rating Body	**Voltage**	**NEMA**	**Receptacle**	**Male Plug**	**Connection**
2 Pole 3 wire	125 250 277V AC	L5-20 L8-20 L7-20	HBL2310 HBL2320 HBL2330	HBL2311 HBL2321 HBL2331	HBL2313 HBL2323 HBL2333
3 Pole 4 wire	125/250V AC 3Ø250V AC 3Ø480V AC	L14-20 L15-20 L16-20	HBL2410 HBL2420 HBL2430	HBL2411 HBL2421 HBL2431	HBL2413 HBL2423 HBL2433
4 Pole 5 wire	3ØY120	L21-20	HBL2510	HBL2511	HBL2513

.8 Wall Plates:

.1 Device plates, dimmer switches plates, telecommunication outlet plates, and blank plates for junction boxes, etc. shall be as follow:

.1 Vertically brushed stainless steel, cover plates 0.04" (1mm) thick for wiring devices mounted in flush-mounted outlet boxes.

.2 Galvanized sheet steel utility box covers for wiring devices installed in surface-mounted utility boxes.

.3 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.4 Ceiling mounted devices cover plates shall match device colour.

2.3 FINISHES

.1 Communication outlet plates, dimmer switch plates and blank plates shall be of the same finish as the electrical cover plates.

.2 Available colours shall be included but not limited to the following:

.1 White
.2 Almond
.3 Black
.4 Brown
.5 Gray
.6 Ivory

2.4 MANUFACTURERS

.1 Provide wiring devices and cover plates of one Manufacturer.

.2 Hubbell Canada LP. Catalogue numbers are shown and indicate the quality of the wiring devices and cover plates required. Equivalent wiring devices and cover plates of the Manufacturers listed below may be use. Acceptable Manufacturers are:

.1 Hubbell Canada LP;

.2 Pass and Seymour;
.3 Leviton Canada;
.4 Lutron Electronics Inc.

3 Execution

3.1 INSTALLATION

.1 Switches:
.1 Install single throw switches with handle in "UP" position when switch closed.
.2 Install switches in gang type outlet box when more than one switch is required in one location.
.3 Mount toggle switches at height specified in Section 26 05 00, or as indicated elsewhere in the Contract Documents.

.2 Receptacles:
.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
.2 Mount receptacles at height specified in Section 26 05 00 or as indicated.
.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.3 Cover plates:
.1 Protect cover plate finish with paper or plastic film until painting and other work is finished.
.2 Install suitable common cover plates where wiring devices and/or dimmer switches are grouped.
.3 Do not use cover plates meant for flush outlet boxes on surface – mounted boxes.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 05 03
.3 Section 26 05 10
.4 Section 26 24 13
.5 Section 26 24 16
.6 Section 26 24 17
.7 Conform to relevant Sections of the Specifications for Division 26 and all other Divisions.

1.2 STANDARDS

.1 CAN/CSA-C22.2 No. 144-M91 (R2001): Ground Fault Circuit Interrupters.

.2 CSA C22.2 No. 5-02: Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

.3 CSA C22.1-02-Canadian Electrical Code.

.4 UL 489 (2002) Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

.5 ANSI C37.17 (latest) American National Standard for trip devices for AC and general purpose DC low voltage power circuit breakers.

.6 NEMA-AB1-1993 Molded case circuit breakers and molded case switches.

.7 ANSI C37.50 American National Standard for Switchgear – test procedures for low voltage AC power circuit breakers used in enclosures.

.8 IEEE Standard 1015, specifically acceptance practice.

.9 NETA –ATS Section 7.

.10 Ontario Electrical Safety Code.

.11 Section 26 05 10.

1.3 PRODUCT DOCUMENTATION

.1 Submit shop drawings in accordance with Section 26 05 00. There will be details such as dimensions, clearances required, cable entries, tabulation of all devices including tags, wiring diagrams (power ,signals, control wiring). The notes will identify field wiring and factory installed wiring).

.2 Include time-current characteristic curves for breakers with ampacity of 150A and over. In some cases, due to critical nature of the equipment smaller size breaker may have to be verified for Time Current coordination as well.

2 Products

2.1 BREAKERS GENERAL

.1 Provide bolt-on molded case circuit breaker, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient as indicated in the Contract Documents.

.2 Circuit breakers that are 400 amps and higher that are part of the emergency distribution system shall be 100% rated.

.3 The purpose of selecting right type of circuit breaker is to comply with Section 26 05 10. The Contractor shall ensure that a necessary study is carried out or professional judgment is sought before offering the breakers. The coordination study must be submitted at the same time as all panelboards, switchboards and any other equipment that is being supplied with molded case circuit breakers. No equipment shall be released for manufacturing prior to the coordination study being approved by the consulting Engineer.

.4 Provide multi-pole breakers with a common-trip device and a single handle.

.5 Provide magnetic instantaneous trip elements in circuit breakers, to operate only when the value of the current reaches the setting, as indicated. For breakers with adjustable trips, provide a trip range of 3 to 10 times the rated current or as indicated in the Contract Documents.

.6 Provide circuit breakers with interchangeable trips as indicated in the Contract Documents.

.7 Provide pad locking devices on all breakers to lock the handle of a breaker in the "on" or "off" position with the trip units to remain free to function and protect the circuit from both overload and short circuit conditions.

2.2 THERMAL MAGNETIC BREAKERS (TMB)

.1 Provide molded case circuit breakers to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping characteristic.

2.3 FUSED THERMAL MAGNETIC BREAKERS (FTMB)

.1 Provide fused thermal magnetic breakers with current limiting fuses internally mounted. Coordinate the time vs current characteristics and the time current limiting characteristics of the fuses with the time vs current tripping characteristics of the circuit breakers resulting in the circuit interruption by the breaker of currents up to the interrupting capacity of the breaker and the circuit interruption by the fuses above the interrupting capacity of the breaker. Provide individually removable fuses interlocked with the breaker such that the removal of the fuse cover, the blowing of a fuse or the removal of a fuse will trip the breaker.

2.4 SOLID STATE TRIP BREAKERS DESIGN (LSI, LSIG AS INDICATED IN THE CONTRACT DOCUMENTS)

.1 Provide molded case circuit breakers to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip devices to

provide an inverse time vs current trip characteristic under overload conditions, and long time short time instantaneous tripping for phase ground fault short circuit protection. The trip unit shall be fully adjustable current and time characteristics. All breakers 400 A and above shall be solid state type (LSIG) unless otherwise shown on Drawings.

2.5 MAGNETIC BREAKERS

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.6 OPTIONAL FEATURES

.1 Provide shunt trip devices, with 120 V AC coils unless otherwise indicated in the Contract Documents, to provide remote tripping where indicated.

.2 Provide closing coils, with 120 V AC coils unless otherwise indicated, to provide remote/automatic closing where indicated in the Contract Documents.

.3 Provide auxiliary switches, rated at 5 A and 120 V unless otherwise indicated in the Contract Documents, to operate remote devices where indicated. Circuit breakers rated 800A or larger shall have contacts rated 10A at 240V where indicated.

.4 Provide motor operated mechanisms, with 120 V motors unless otherwise indicated, to provide remote operation where indicated. This will be provided with electrical closing mechanism where indicated.

.5 Provide NEMA and UL rated enclosures for individual breakers as required.

2.7 MANUFACTURERS

.1 Provide circuit breakers of one Manufacturer. Acceptable Manufacturers are:
- .1 Schneider Electric
- .2 Eaton Electric
- .3 Siemens

3 Execution

3.1 EXAMINATION

.1 Examine the circuit breakers for compliance with installation tolerances and other conditions affecting performance. Proceed with installation only after satisfactory compliance has been confirmed.

3.2 INSTALLATION

.1 Circuit breakers in panelboards shall be factory installed.

.2 Install other individual breakers where indicated in the Contract Documents.

3.3 IDENTIFICATION

.1 Identify all field installed conductors, wiring and components; provide warning signs as required by manufacturer and also CEC and Ontario Electrical Safety Code. Install engraved nameplates and lamacoid nameplates on enclosures.

3.4 CONNECTION

.1 Install grounding connections, power wiring and indication devices. Verify the torque recommended by Manufacturer.

3.5 TESTS

.1 Test for continuity of phase and ground connections and insulation resistance (Megger) for each phase to phase and phase to ground.

.2 Verify all acceptance tests as per NETA test procedure.

.3 Any malfunctioning of the units shall be corrected and retested to demonstrate compliance.

3.6 SUBMITTALS

.1 Field test reports: Include the test procedures and instruments used. Record test results for formal submission to Consultant and Owner.

.2 Final maintenance manual shall include all the routine maintenance requirements and complete information about each circuit breaker settings.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 05 03
.3 Section 26 05 10
.4 Section 26 24 16
.5 Conform to relevant Sections of the Specifications for Division 26 and all other Divisions.

1.2 PRODUCT DATA

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

.2 Standards: Design, manufacture and test all disconnect switches in accordance with good industry practice and in accordance with the following Standards and Codes:

.3 CSA Standard C22.2 No. 4 Enclosed switches;

.4 CSA Standard C22.2 No. 39 Fuseholder assemblies.

2 Products

2.1 DISCONNECT SWITCHES

.1 Provide fusible and non-fusible disconnect switches in CSA Enclosure to suit the environment where the switch is located.

.2 Provide the provision for padlocking the switch in the ON and OFF switch position by using one lock via a multi-lock hasp.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated.

.5 Fuseholders: suitable without adaptors, for type and size of fuse indicated.

.6 Provide a type A quick-make, quick-break switching action with arc chutes or arc snuffers.

.7 Provide a vertically moving handle with an ON-OFF switch position indication on the switch enclosure cover with the ON position being the upper handle position.

.8 Provide solderless neutral terminals where indicated.

.9 Disconnect switches integrated rating must be rated to handle the design interrupting capacity for this project.

.10 Ensure system coordination per Section 26 05 10 prior to ordering of the equipment.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Indicate name of load controlled on nameplate.

.3 If part of the emergency distribution system, it shall be finished in Sherwin Williams #F65E37.

2.3 ACCEPTABLE MANUFACTURERS

.1 Provide disconnect switches which are the product of one Manufacturer. Acceptable manufacturers are:
- .1 Schneider Electric
- .2 Eaton Canada.
- .3 Siemens Canada.

2.4 ENCLOSURE

.1 Individually mounted disconnect switch shall be installed in Sprinkler proof enclosure c/w drip shield.

3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

1 General

1.1 SCOPE

.1 Provide complete factory assembled generator set equipment with digital electronic controls.

.2 Provide factory test, start-up by a Supplier authorized by the Manufacturer, and on-site testing of the system.

.3 The generator set Manufacturer shall warrant all equipment provided under this Section so that there is one source for warranty and product service. 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 RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 05 03
.3 Section 26 28 21
.4 Section 26 36 23
.5 Conform to relevant Sections of the Specifications for Division 15 and all other Divisions.

1.3 STANDARDS

.1 The generator set Manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

.2 CSA C-282-15 Emergency Electrical Power Supply for Buildings.

.3 ISO 8528 – Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets.

.4 IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.

.5 NFPA 70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.

.6 NFPA 110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1prototype 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.

.7 UL2200. The genset shall be listed to UL2200 or submit to an independent third-party certification process to verify compliance as installed.

.8 Designed to allow for installed compliance to NFPA 37, NFPA 70, NFPA 99 and NFPA 110.

.9 UL 489 (2002) Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

.10 NEMA-AB1-1993 Molded case circuit breakers and molded case switches.

.11 NETA –ATS Section 7.

.12 Ontario Electrical Safety Code.

.13 Acceptable Manufacturers:
.1 Cummins, Kohler Power, or approved equivalent

1.4 PRODUCT DOCUMENTATION

.1 Submit shop drawings in accordance with Section 26 05 00.

2 Products

2.1 GENERATOR SET REQUIREMENTS

.1 The natural gas outdoor rated generator set shall be Standby Duty rated at 150 kW, 187.5 kVA, 1800 RPM, 0.8 power factor, 600 VAC, 3-Phase, 60 hertz, including radiator fan and all parasitic loads. Generator set shall be sized to operate at the specified load at a maximum ambient of 77°F (25.0°C) and altitude of 500.0’ (152.4m).

.2 Standby Power Rating: 150 kW, 187.5 kVA, 1800 RPM, 0.8 power factor, 600 VAC, 3-Phase, 60 hertz.

.3 Power is available for the duration of an emergency outage.

.4 Average Power Output: 70% of standby power.

.5 Load: Varying.

.6 Typical Hours/Year: 200 Hours.

.7 Maximum Expected Usage: 500 hours/year.

.8 Typical Application: Standby.

2.2 MATERIAL AND PARTS

.1 All materials and parts comprising the unit shall be new and unused.
.1 Engine:
.1 The engine shall be pipeline natural gas, four cycle, water-cooled, while operating with nominal speed not exceeding 1800 RPM.
.2 The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories.
.2 Engine Governing:
.1 The engine will be equipped with an isochronous electronic governor to maintain +/-0.7% steady state frequency variation from steady state no load to steady state full load.

2.3 GENERATOR

.1 Generator Specifications:
.1 The synchronous three phase generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly

connected to the engine flywheel housing with a flex coupling. The generator shall meet performance class G2 of ISO 8528. The excitation system shall enable the alternator to sustain 300% of rated current based on the 125C (Class H) rise rating for 10 seconds during a fault condition and shall improve the immunity of the voltage regulator to non-linear distorting loads. The excitation system shall be Permanent magnet type, of brushless construction and be independent of main stator windings.

.2 Voltage Regulator:

.1 Integrated Voltage Regulator (IVR): The IVR shall maintain generator output voltage within +/- 0.25% for any constant load between no load and full load. The regulator shall be capable of sensing true RMS in three phases of alternator output voltage or operating in single phase sensing mode. The IVR shall be cable of configuring knee frequency and voltage regulation configurable up to +/-30%. The voltage regulator shall include a VAR/Pf control feature as standard. The regulator shall provide an adjustable dual slope regulation characteristic in order to optimize voltage and frequency response for site conditions. The IVR shall be capable of setpoint adjustment.

.3 Motor Starting:

.1 Provide locked rotor motor starting capability of a min of 187.5 kVA at 30% instantaneous voltage dip as defined per NEMA MG 1. Sustained voltage dip data is not acceptable.

2.4 CIRCUIT BREAKER

.1 Circuit Breaker Specifications

.1 Provide a generator mounted 100% circuit breaker, molded case, Qty. (1) 225A trip, 3 pole, NEMA 1/IP22. Breaker shall utilize a solid-state trip unit. The breaker shall be connected to engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box which is isolated from vibrations induced by the generator set. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker.

.2 Provide a second generator mounted 100% circuit breaker with shunt trip, molded case, Qty. (1) 225A trip, 3 pole, NEMA 1/IP22. This breaker will be utilized for load bank testing.

.3 The generator breaker/s mounted on the generator set shall be capable of being locked in the open position with a pad lock.

2.5 CONTROLS – GENERATOR SET MOUNTED

.1 Provide a fully solid-state, microprocessor based, generator set control. The control panel shall be designed and built by the engine Manufacturer. The control shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to all engine and regulator controls via SAE J1939.

.2 Environmental:

.1 The generator set control shall be tested and certified to the following environmental conditions:

.1 –30°C to +70°C Operating Range
.2 20°C to +55°C @ 95%relative humidity for 48 hours
.3 IP22 protection for rear of controller; IP42 when installed in control panel
.4 Sinusoidal vibration 10 sweeps in 3 major axis:5 to 8Hz @ +/- 7.5mm, 5 to 500Hz @ 2G
.5 Electromagnetic Capability (89/336/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC, BS EN 50081-2, 50082-2, BS EN 61000-6-2, BS EN 61000-6-4)
.6 Shock: withstand 15G for 11ms

.3 Functional Requirements:
.1 The following functionality shall be integral to the control panel.
.1 The control shall include a minimum 64 x 132-pixel LCD display
.2 The control shall include a minimum of 3-line data display
.3 Audible horn for alarm and shutdown with horn silence switch
.4 Standard ISO labeling
.5 Multiple language capability
.6 Remote start/stop control
.7 Local run/off/auto control integral to system microprocessor
.8 Cooldown timer
.9 Speed adjusts
.10 Lamp test
.11 Emergency stop push button
.12 Password protected system programming

.4 Digital Monitoring Capability
.1 The controls shall provide the following digital readouts for the engine and generator. All readings shall be indicated in either metric or English units.
.1 Engine:
.1 Engine oil pressure
.2 Engine oil temperature
.3 Engine coolant temperature
.4 Engine RPM
.5 Battery volts
.6 Engine hours
.7 Engine crank attempt counter
.8 Engine successful start counter
.9 Service maintenance interval
.10 Real time clock
.11 Engine exhaust stack temperature
.12 Engine main bearing temperature
.2 Generator
.1 Generator AC volts (Line to Line, Line to Neutral and Average)
.2 Generator AC current (Avg and Per Phase)
.3 Generator AC Frequency
.4 Generator kW (Total and Per Phase)
.5 Generator kVA (Total and Per Phase)
.6 Generator kVAR (Total and Per Phase)
.7 Power Factor (Avg and Per Phase)

.8 Total kW-hr
.9 Total kVAR-hr
.10 % kW
.11 % kVA
.12 % kVAR

.5 Generator Set Alarms and Shutdowns:

.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 LED 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/over crank (shutdown)
.11 Overspeed (shutdown)
.12 Low dc voltage (alarm)
.13 High dc voltage (alarm)
.14 Weak battery (alarm)
.15 Low fuel (alarm)
.16 Low ac voltage (shutdown)
.17 Under frequency (shutdown)
.18 Over current (warning)
.19 Over current (shutdown)
.20 Short circuit (shutdown)
.21 Overload (alarm)
.22 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.

.3 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.

.6 Inputs and Outputs

.1 Programmable Digital Inputs

.1 The Controller shall include the ability to accept programmable digital input signals. The signals may be programmed for either

high or low activation using programmable Normally Open or Normally Closed contacts.

.2 Programmable Discrete Outputs

.1 The control shall include the ability to operate eight discrete outputs, integral to the controller, two which are rated at 5A continuous, six rated 2A continuous.

.7 Maintenance

.1 All engine, voltage regulator, control panel and accessory units shall be accessible through a single electronic service tool. The following maintenance functionality shall be integral to the generator set control.

.1 Engine running hours display
.2 Service maintenance interval (running hours or calendar days)
.3 Engine crank attempt counter
.4 Engine successful starts counter
.5 40 events are stored in control panel memory

.2 Programmable cycle timer that starts and runs the generator for a predetermined time. The timer shall use 7 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:

.1 Day of week
.2 Time of day to start
.3 Duration of cycle

.8 Remote Communications

.1 The control shall include Modbus RTU communications as standard via RS-485 half duplex with configurable baud rates from 2.4k to 57.6k.

.9 Annunciation

.1 Compatible remote annunciator option
.2 Battery charger communication
.3 Input/outputs expansion module compatible

2.6 COOLING SYSTEM

.1 Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame, radiator duct flange and integral engine-driven coolant pump.

.2 Coolant: Solution of 50% ethylene-glycol-based antifreeze and 50% water, with anticorrosion additives as recommended by engine Manufacturer.

2.7 FUEL SYSTEM

.1 Fuel System (Natural Gas)

.1 The fuel system shall be integral with the engine. A flexible fuel line shall be plumbed to the generator set skid base for ease of customer connection. A secondary gas pressure regulator shall be installed integral to the generator set package capable of regulating the incoming gas pressure from 7-11” of water for the engine fuel system.

2.8 STARTING SYSTEM

.1 Starting Motor
- .1 A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine Manufacturer.

.2 Jacket Water Heater
- .1 Jacket water heater shall be provided and shall be sized to insure that genset will start within the specified time period and ambient conditions.

.3 Batteries
- .1 Batteries - A lead-acid storage battery set of the heavy-duty starting type shall be provided. Battery voltage shall be compatible with the starting system.

.4 Battery Charger
- .1 A current limiting battery charger shall be furnished to automatically recharge batteries. The charger shall be dual charge rate with automatic switching to the boost rate when required. The battery charger shall be mounted on the genset package or inside the genset enclosure/room.

2.9 ENCLOSURE

.1 Attenuated Enclosure (Standard Sound optional)
- .1 The complete engine generator set, including generator control panel, engine starting batteries and fuel oil tank, shall be enclosed in a factory assembled, sound attenuated enclosure.
- .2 A weather resistant outdoor rated, sound attenuated enclosure of steel with electrostatically applied powder coated baked polyester paint. The enclosure shall have a resulting sound level of 74dba @ 23' with the genset running under full load. It shall consist of a roof, side walls, and end walls. Fasteners shall be either zinc plated or stainless steel.
- .3 Enclosure Sound Attenuation: Acoustical foam shall be provided between all supports and inside doors and sound baffles on air intake and air discharge.

2.10 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 and a redundant signal over the required network connection.

.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 signalled 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 disconnecting 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.

.4 On completion of the time delay stop period (cool down time set as per the Manufacturers recommendations), 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.

2.11 SUBMITTALS

.1 In accordance with Contract requirements, provide six sets of the following information for review:

.1 Manufacturer’s product literature and performance data, sufficient to verify compliance to Specification requirements.

.2 A paragraph-by-paragraph Specification compliance statement, describing the differences between the specified and the proposed equipment.

.3 Manufacturer's certification of prototype testing.

.4 Manufacturer's published warranty documents.

.5 Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.

.6 Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point to point manner.

.7 Manufacturer's installation instructions.

2.12 CLOSE OUT SUBMITTALS

.1 Provide operation and maintenance data for natural gas generator for incorporation into manual specified in Contract Documents.

.2 Include in Operation and Maintenance Manual instructions for particular unit supplied and not general description of units manufactured by Supplier and:

.1 Operation and maintenance instructions for engine, alternator, control panel, automatic transfer switch, manual bypass switch, battery charger, battery, fuel system, engine room ventilation system, exhaust system and accessories, to permit effective operation, maintenance and repair.

.3 Technical data:
- .1 Illustrated parts lists with parts catalogue numbers.
- .2 Schematic diagram of electrical controls.
- .3 Flow diagrams for:
  - .1 Fuel system.
  - .2 Lubricating oil.
  - .3 Cooling system.
- .4 Certified copy of factory test results.
- .5 Maintenance and overhaul instructions and schedules.
- .6 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.
- .7 Provide two sets of operation and maintenance manuals covering the generator, switchgear, and auxiliary components. Include final as-built wiring interconnect diagrams and recommended preventative maintenance schedules.

2.13 FACTORY TESTING

.1 The generator set Manufacturer shall perform a 4 Hour complete operational test on the generator set prior to shipping to the site. A certified test report shall be provided. Equipment supplied shall be fully tested for function and performance.

.2 Factory testing may be witnessed by the Owner and Consulting Engineer. If the factory test is to occur a distance further than 200km from the site, costs for travel expenses will be the responsibility of the Contractor. Factory testing must be undertaken at a site within Canada. Supplier is responsible to provide 2 week's notice for testing.

.3 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.

2.14 SPARE PARTS

.1 Provide the following spare parts:
- .1 Provide engine oil drip tray, 1.5mm minimum, galvanized steel with 50mm lip suitable for location on the concrete pad. The tray shall extend completely under the generator set, between the vibration isolators and easily removable without disturbing any components.
- .2 Special tools, spare parts shall be provided by the Supplier, which are non-standard off the shelf items.
- .3 Provide three sets of fuel oil filter elements and gaskets.
- .4 Provide three lubricating oil filter elements and gaskets.
- .5 Provide one air cleaner filter element.
- .6 Provide two sets V-belts for fan and pump drives.

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 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.

.4 Equipment shall be initially started and operated by representatives of the Manufacturer.

.5 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 initial operation and final testing of the system.

3.2 ON-SITE ACCEPTANCE TEST

.1 The complete installation shall be tested under full load for 4 Hours to CSA C282-15 standards 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/Owner shall be notified in advance and shall have the option to witness the tests.

.2 Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.

3.3 TRAINING

.1 The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration. Training date shall be coordinated with the facility Owner.

3.4 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.

3.5 WARRANTY

.1 Five Year Standby (ISO 8528-1: ESP) Generator Set Warranty

.1 The Manufacturer's standard warranty shall in no event be for a period of less than 5 years from date of initial start-up of the system and shall include repair parts, labor, travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Manufacturer and servicing distributor shall provide free of charge similar size temporary generator set if the repair during warranty period will take more than 48 hours. All repairs will be performed by factory trained dealer service personnel.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Section 26 05 03
.3 Section 26 05 10
.4 Section 26 32 10
.5 Conform to relevant Sections of Specification for this and other Divisions.

1.2 REFERENCES

.1 CSA C22.2 No. 178, Standard for Transfer Switch Equipment.

.2 CAN3-C13-M83, Instrument Transformers.

.3 ANSI/NEMA ICS 2-1988, Industrial Control Devices, Controllers, and Assemblies.

.4 CSA Part 1 – Canadian Electrical Code.

1.3 SYSTEM DESCRIPTION

.1 Automatic load transfer equipment to:
  .1 Monitor voltage on all phases of normal power supply.
  .2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below pre-set adjustable limits for adjustable period of time.
  .3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.
  .4 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on all phases above adjustable pre-set limit for adjustable time period.
  .5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

1.4 SHOP DRAWINGS

.1 Submit shop drawings.

.2 Include:
  .1 Make, model and type.
  .2 Load classification:
  .3 Single line diagram showing controls and relays.
  .4 Description of equipment operation including:
    .1 Automatic starting and transfer to standby unit and back to normal power.
    .2 Test control.
    .3 Manual control.
    .4 Automatic shutdown.

1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in Section 01 33 00.

.2 Detailed instructions to permit effective operation, maintenance and repair.

.3 Technical data:
- .1 Schematic diagram of components, controls and relays.
- .2 Illustrated parts lists with parts catalogue numbers.
- .3 Certified copy of factory test results.

1.6 ACCEPTABLE MANUFACTURERS

.1 ASCO 7000 Series

.2 Approved equal.

2 Products

2.1 MATERIALS

.1 Instrument transformers: to CAN3-C13.

.2 Contactors: to ANSI/NEMA ICS 2.

2.2 CONTACTOR TYPE TRANSFER EQUIPMENT

.1 The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism.

.2 Front access only.

.3 Two 3 phase contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, with sprinkler proof enclosure.

.4 Rated: 600 V, 60 Hz, amp and no of poles, as indicated in Contract Documents.

.5 Main contacts: silver surfaced, protected by arc disruption means.

.6 Switches and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.

.7 Auxiliary contact: silver plated, to initiate emergency generator start-up on failure of normal power, and two N/C, two N/O.

.8 Fault withstand rating:
- .1 50 kA, symmetrical minimum for ratings larger than 400A.
- .2 50 kA symmetrical , or as indicated, for ratings 400A and below.
- .3 Confirm to the Short Circuit, System Coordination and Arc Flash Study.

.9 The transfer switch shall be built for closed transition operation, with capability to support open transition or delayed transition modes.

2.3 MICROPROCESSOR CONTROLLER

.1 The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.

.2 A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to ± 1% of nominal voltage. Frequency sensing shall be accurate to ± 0.2%. The panel shall be capable of operating over a temperature range of -20 to +60°C and storage from -55 to +85°C.

.3 The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.

.4 All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

.5 The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:

.1 IEEE472 (ANSI C37.90A) Ring Wave Test.
.2 ENC55011 1991 Class A Conducted and Radiated Emission.
.3 EN61000-4-2 Electrostatic Discharge Immunity, Direct Contact & Air Discharge.
.4 EN61000-4-3 Radiated Electromagnetic Field Immunity.
.5 EN61000-4-4 Electrical Fast Transient Immunity.
.6 EN61000-4-5 Surge Immunity.
.7 ENV50141 HF Conducted Disturbances Immunity

.6 Controller Display and Keypad.

.1 A four line twenty character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:

.1 Nominal line voltage and frequency.
.2 Single or three phase sensing.
.3 Operating parameter protection.
.4 Transfer operating mode configuration (Open transition, Closed transition or Delayed transition).

.2 All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

.7 Voltage, Frequency and Phase Rotation Sensing.

.1 Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored with the following pickup, dropout and trip setting capabilities (values as shown as % of normal unless otherwise specified):

Parameter	Sources	Dropout/Trip	Pickup/Reset
Undervoltage	N&E, 3Æ	70 to 98%	85 to 100%
Overvoltage	N&E, 3Æ	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

.2 Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of –20° to 60°C.

.3 Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

.4 The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

.5 Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

.8 Time Delays.

.1 An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.

.2 A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

.3 Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails, and the normal source is acceptable.

.4 A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

.5 A time delay activated output signal (ASCO Acc.31Z) shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:

.1 Prior to transfer only.

.2 Prior to and after transfer.

.3 Normal to emergency only.

.4 Emergency to normal only.

.5 Normal to emergency and emergency to normal.

.6 All transfer conditions or only with both sources are available.

.6 All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.

.7 All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

.8 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches pre-set adjustable values.

2.4 BYPASS-ISOLATION SWITCH

.1 A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.

.2 Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control inter-wiring shall be provided with disconnect plugs.

.3 Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.

.4 Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs which disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.

.5 The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.

.6 When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.

.7 Designs requiring operation of key interlocks for bypass isolation or ATSs which cannot be completely withdrawn when isolated are not acceptable.

2.5 ADDITIONAL FEATURES

.1 A three position momentary-type test switch shall be provided for the test/automatic/reset modes. A two position maintained contact switch for manual/engine start.

- .1 Test position - Normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.
- .2 Auto position - Normal operation of transfer switch on failure of normal power; retransfer on return of normal voltage and shuts down engine.
- .3 Manual position - Transfer switch may be operated by manual handle, but transfer switch will not operate automatically, and engine will not start.
- .4 Engine start position - Engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.

.2 The following features shall be built-in to the controller, but capable of being activate through keypad programming or the serial port only when required by the user.

.3 A set of DPDT gold-flashed contacts rated 10 amps, 32 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

.4 Quantity of four Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.

.5 LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

.6 LED indicating lights (16mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.

.7 Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.

.8 Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.

.9 An Inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents do not exceed normal starting currents and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS Manufacturer.

.10 The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.

.11 Engine Exerciser – The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:

.1 Enable or disable the routine.

.2 Engine or disable transfer of the load during routine.

.3 Set the start time:

.1 Time of day.

.2 Day of week.

.3 Week of month (1st, 2nd, 3rd, 4th, alternate or every).

.4 Set the duration of the run.

.5 At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10 year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

.12 System Status – the controller LCD display shall include a “System Status” screen which shall be readily accessible from any point in the menu by depressing the “ESC” key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example:

.1 Normal Failed

.2 Load on Normal

.3 TD Normal to Emergency

.4 2min 15s.Controllers that require multiple screens to determine system status or display “coded” system status messages, which must be explained by references in the operator’s manual, are not permissible.

.13 Self-Diagnostics – The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

.14 Data Logging – The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:

.1 Event Logging:

.1 Data and time and reason for transfer to normal to emergency.

.2 Data and time and reason for transfer emergency to normal.

.3 Data and time and reason for engine start.

.4 Data and time engine stopped.

.5 Data and time emergency source available.

.6 Data and time emergency source not available.

.2 Statistical Data:

.1 Total number of transfers.

.2 Total number of transfers due to source failure.

.3 Total number of days controller is energized.

.4 Total number of hours both normal and emergency sources are available.

2.6 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Control panel:
- .1 For selector switch and manual switch: size 5 nameplates.
- .2 For meters, indicating lights, minor controls: size 3 nameplates.

2.7 ENCLOSURE

.1 The ATS/BPS shall be furnished in a sprinkler proof type enclosure unless otherwise shown on the plans.
- .1 Exterior paint colour:
- .2 Grey Interior paint colour: Grey.

.2 All standard and optional door-mounted switches and pilot lights shall be 16mm industrial grade type or equivalent for easy viewing and replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose for open type units.

.3 Provide sprinkler-proof construction including gasketing and drip shield, when installed in sprinklered rooms.

2.8 SOURCE QUALITY CONTROL

.1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested in presence of Consultant.

.2 Notify Consultant 10 days in advance of date of factory test.

.3 Tests:
- .1 Operate equipment both mechanically and electrically to ensure proper performance.
- .2 Check selector switch, in all modes of operation Test, Auto, Manual, Engine Start and record results.
- .3 Check voltage sensing and time delay relay settings.
- .4 Check:
  - .1 Automatic starting and transfer of load on failure of normal power.
  - .2 Retransfer of load when normal power supply resumed.
  - .3 Automatic shutdown.
  - .4 In-phase monitor operation.

3 Execution

3.1 INSTALLATION

.1 Locate, install and connect transfer equipment.

.2 Check relays and adjust as required.

.3 Install and connect battery and remote alarms.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00.

.2 Energize transfer equipment from normal power supply.

.3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.

.4 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 min, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.

.5 Repeat, at 1 hour intervals, several times, complete test with selector switch in each position, for each test.

.6 The complete Transfer Switch shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the Specification requirements.

.7 Upon request, the Manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this Specification including compliance with the above codes and standards and withstand and closing ratings.
The certification shall identify, by serial numbers(s), the equipment involved. No exceptions to the specification, other than those stipulated at the time of the submittal, shall be included in the certification.

3.3 PROTECTION

.1 Provide on-site support and technical data to Electrical Contractor during installation.

.2 Provide representative during commissioning to set trips, inspect installation and witness commissioning.

.3 Provide written confirmation that installation and commissioning have been fully completed to Manufacturer’s satisfaction.

3.4 WORKMANSHIP

.1 Notify Employer in advance prior to factory test so that Employer may attend.

.2 Install meters and switches to permit easy reading.

.3 Install all equipment and apparatus requiring maintenance, adjustment or replacement with sufficient clearance for servicing.

.4 Install control devices to guarantee proper sensing. Shield element from direct radiation and void placing them behind obstruction.

.5 Include In the work all requirements of Manufacturer shown on the shop drawings.

.6 Replace any work unsatisfactory to the Engineer without extra cost.

3.5 CONTROL WIRING & ALARMS

.1 Wire all wiring to control terminals and provide all interface Drawings and details for onsite wiring by Electrical Control, when one is appointed on-site.

3.6 COMPLETION

.1 Clean all equipment. Polish all plated surfaces.

.2 Set all relays to operating condition.

.3 Remove all temporary protection and cover, and vacuum clean inside switchgear.

END OF SECTION

1 General

1.1 REFERENCES

.1 The following is a list of standards which may be referenced in this Section:

- .1 Institute of Electrical and Electronic Engineers (IEEE): C62.41, Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits.
- .2 Canadian Standards Association CSA C22.1 No. 141 Unit Equipment for Emergency Lighting.
- .3 Certified Ballast Manufacturer (CBM).
- .4 Federal Communications Commission (FCC).
- .5 Illuminating Engineering Society of North America (IESNA).
- .6 National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
- .7 American National Standards Institute (ANSI)
  - .1 ANSI C78.377-2008 Specifications for the Chromaticity of Solid State Lighting Products;
  - .2 ANSI C 82.77-2002 Harmonic Emission Limits – Related Power Quality Requirements for Lighting;
  - .3 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE);
  - .4 ANSI C62.41.1-2002 – IEEE Guide on the Surge Environment in Low-Voltage (1000V and less) AC Power Circuits;
  - .5 ANSI C62.41.2-2002 – IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000W and less) AC Power Circuits;
  - .6 ANSI C82.SSL1 – SSL Drivers;
  - .7 ANSI C82.77-2002 Harmonic Emission Limits.
- .8 Illuminating Engineering Society (IES).
  - .1 G-2-10 Guideline for the Application of General Illumination (“White”) Light-Emitting Diode (LED) Technologies;
  - .2 LM-79-08 Approved Method: Electrical and Photometric Testing of Solid-State Lighting Devices;
  - .3 LM-80-08 Approved Method: Measuring Lumen Depreciation of LED Light Sources;
  - .4 LM-82-12 Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature;
  - .5 RP-16-10 Nomenclature and Definitions for Illuminating Engineering;
  - .6 TM-16-05 Light Emitting Diode (LED) Sources and Systems;
  - .7 TM-21 -11 Projecting Long Term Lumen Maintenance of LED Light Sources.
- .9 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2, General Requirements – Canadian Electrical Code Part II.

.3 CSA C22.2 No.141-15, Unit Equipment for Emergency Lighting. CSA C68.3 Power Cables with Thermoset Insulation.
.4 CSA C860-11, Performance of Internally-Lighted Exit Signs. CSA C21.2 300 V Control Cable.
.5 National Fire Protection Association (NFPA)
.1 NFPA 101-2006, Life Safety Code IEEE 848 Standard Procedure for the Determination of the Ampacity Derating of Fire-Protected Cables
.6 National Building Code of Canada 2015(NBC)
.10 National Electrical Manufacturers Association (NEMA)
.1 SSL-1-2010 Electronic Drivers for LED Devices, Arrays, or Systems;
.2 SSL-3-2010 High-Power White LED Binning for General Illumination.
.11 Underwriters Laboratories, Inc. (ULC):
.12 NFPA No. 101 Life Safety Code.
.13 Ontario Electrical Safety Code.

1.2 SUBMITTALS

.1 Submit shop drawings in accordance with Section 26 05 00, and the requirements of Division 1.

.2 Where the Architect is to select colours and finish of lighting fixtures after award of Contract, it shall be the responsibility of the Contractor for Division 26 to obtain this information during the shop drawing submittal/review stage.

.3 Action Submittals:
.1 Shop Drawings:
.1 Interior Luminaires:
.1 Catalogue data sheets and pictures.
.2 Luminaire finish and metal gauge.
.3 Lens material, pattern, and thickness.
.4 Driver data sheet with system efficacy.
.5 Candle power distribution curves in two or more planes.
.6 Candle power chart 0 to 90°.
.7 Lumen output chart.
.8 Mounting details.
.2 Exterior Luminaires:
.1 Catalogue data sheets and pictures.
.2 Luminaire finish and metal gauge.
.3 Lens material, pattern, and thickness.
.4 Driver data sheet with system efficacy.
.5 IESNA lighting classification and isolux diagram.
.6 Fastening details to wall or pole.
.3 LED Chipsets:
.1 Colours.
.2 Approximate life (in hours) to L70 requirements.
.3 Approximate initial lumens.
.4 Lumen maintenance curve.
.5 CRI.

.4 Drivers:
- .1 Type.
- .2 Wiring diagram.
- .3 Approximate life (in hours).
- .4 Nominal watts and input watts.
- .5 Input voltage and power factor.
- .6 Starting current.
- .7 Temperature rating.
- .8 Efficacy ratings.
- .9 Low temperature characteristics.

.5 Photo Time Control:
- .1 Wiring diagram.
- .2 Contact ratings.

.6 Photocells:
- .1 Voltage, and power consumption.
- .2 Ampacity.
- .3 Contacts and time delay.
- .4 Operating levels.
- .5 Enclosure type and dimensions.
- .6 Mounting details.
- .7 Temperature range.

.7 Occupancy Sensors:
- .1 Type.
- .2 Switching capacity.
- .3 Coverage.
- .4 Time delay AUTO/OFF adjustment.
- .5 Mounting details.

.8 Low Voltage Remote Control Wiring System:
- .1 Type.
- .2 Switching capacity.
- .3 Voltage rating.
- .4 Wiring diagrams.

1.3 WARRANTY

.1 All lighting systems components shall be supplied the Manufacturer's standard warranty, a minimum 1 year warranty.

.2 Extended warranties shall be submitted within Operating and Maintenance manuals as detailed in Section 26 05 00.

1.4 QUALITY ASSURANCE

.1 Pre-installation Meeting:
- .1 Occupancy Sensors: Arrange a pre-installation meeting with the Manufacturer's factory authorized representative at the project site, to verify placement of sensors and installation criteria.

.2 Extra Materials: Furnish, tag, and box for shipment and storage, the following spare parts:

Item	Quantity
LH1	Two complete units

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Construction Quality Management Plan. Store in original cartons, in a dry and protected space.

.2 Deliver materials to site in original factory packaging, labelled with Manufacturer's name, address.

.3 Packaging Waste Management: Remove for reuse and return by Manufacturer of pallets, crates, packaging materials and padding in accordance with Section 01 74 00.

.4 Divert unused metal materials from landfill to metal recycling facility.

.5 Disposal and recycling of fluorescent lamps as per local regulations.

.6 Disposal of old PCB filled ballasts.

2 Products

2.1 LUMINAIRES

.1 See the Lighting Fixture Schedule on the Drawings.

.2 Wire Leads: Minimum 18 AWG.

.3 Component Access: Accessible and replaceable without removing luminaire from ceiling.

.4 Soffit Installations:
- .1 ULC Labeled: SUITABLE FOR DAMP LOCATIONS.
- .2 Driver: Removable, prewired.

.5 Exterior Installations:
- .1 ULC Labeled: SUITABLE FOR WET LOCATIONS.
- .2 Driver: Removable, prewired.
- .3 When factory installed photocells are provided, entire assembly shall have ULC label.

2.2 LED CHIPSETS

.1 See the Luminaire Schedule.

2.3 DRIVERS

.1 General:
- .1 Meet requirements for fixture light output, reliable starting, radio interference, total harmonic distortion, electromagnetic interference, and dielectric rating.
- .2 Certified by electrical testing laboratory to conform to CBM specifications.
- .3 Power factor of 98% or greater.
- .4 Driver lifespan shall exceed 100,000 hours.
- .5 Total harmonic distortion (THD) shall be less than 5%.

.6 Shall withstand line transients per IEEE C62.41, Cat A.
.7 Driver shall start lamp at a minimum temperature of 10°C for indoor fixtures, and -30°C for outdoor fixtures.
.8 Driver input voltage shall match luminaire input voltage. Use of separate internal matching transformers shall only be permitted if the lifespan of the transformer exceeds that of the driver. Submit transformer cut sheet information with driver submittal if that is considered as part of the luminaire.
.9 Dimming control shall be according to Luminaire Schedule.

2.4 LIGHTING CONTROL

.1 Photocell:
- .1 Automatic raise/lower and ON/OFF switching photo control.
- .2 Housing: Self contained, die cast aluminum, unaffected by moisture, vibration, or temperature changes.
- .3 Setting: ON at dusk and OFF at dawn.
- .4 Time delay feature to prevent false switching.
- .5 Field adjustable to control operating levels.
- .6 Shall be compatible with LED driver and/or lighting control system.

.2 Occupancy Sensors:
- .1 Dual Technology Units:
  - .1 Unit to be ceiling mounted for 180° or 360° coverage. Locate and aim sensors to achieve best coverage of controlled areas per the manufacturer's recommendations.
  - .2 Unit shall utilize both passive infrared and ultrasonic technologies and be easily programmed to accommodate different environmental and architectural conditions.
  - .3 Unit must detect up to 2,000ft² with no blind spots.
  - .4 No audio dual technology units will be accepted.
  - .5 Shall be compatible with LED driver and/or lighting control system.
- .2 Power Packs:
  - .1 Able to mount through a 13mm knock out in a standard electrical enclosure and be an integrated, self contained unit consisting internally of an isolated load switching control relay and a transformer to provide low voltage power. Transformer shall provide power to a minimum of two sensors.
  - .2 Relay contacts shall have ratings of:
    - .1 13A, 120V AC tungsten.
    - .2 20A, 120V AC driver.

.3 Wiring: Control wiring between sensors and control units shall be Class II, 14 AWG, stranded, PVC insulated, or Teflon jacketed cable approved for use in plenums, where applicable.

.4 General:
- .1 Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to cycling of air conditioner or heating fans.
- .2 Sensors shall have readily accessible, user adjustable controls for time delay and sensitivity.

.3 In event of failure, bypass manual OVERRIDE ON key shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

.4 Power Packs shall have an extra Form C (1 NO 1 NC) contact for interface with building system. Units shall be designed to be mountable in standard electrical box.

.5 All lighting control devices shall be compatible with the overall lighting system.

.6 Manufacturers:

.1 Lutron

.2 Leviton Mfg. of Canada, Ltd.

.3 Douglas

.4 Or, approved equal

2.5 SURGE PROTECTION FOR LED SYSTEMS

.1 Luminaire manufacturers supplying exterior LED luminaires are to include surge protection for LED systems in accordance with IEEE and ANSI C62.41.2 transient surge requirements. Surge protection to be level of 6 kV/3 kA for low exposure conditions (low grade level landscape lighting) and, 10 kV/10 kA for high exposure conditions (pole mounted lighting).

3 Execution

3.1 LUMINAIRES

.1 General:

.1 Install in accordance with the Manufacturer’s recommendations.

.2 Provide proper hangers, pendants, and canopies as necessary for complete installation.

.3 Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building and to concrete pole bases required to safely mount.

.4 Install plumb and level.

.5 Mounting heights shown on the Drawings for pendant mounted luminaires are measured from bottom of luminaire to finished floor or finished grade, whichever is applicable.

.6 Mounting heights shown on the Drawings for wall mounted luminaires are measured from center of mounting plate to finished floor or finished grade, whichever is applicable.

.7 Install each luminaire outlet box with galvanized stud.

.8 Verify weight and mounting method of all luminaires prior to ordering and provide suitable support. Coordinate with General Contractor for luminaires that require additional blocking or support. Luminaire mounting assemblies shall comply with all local seismic codes and regulations.

.9 Protective material to remain on luminaires until prior to commissioning. At commissioning, clean luminaires as in new condition.

.10 Do not daisy-chain light fixture wiring. Provide junction boxes and individual wiring to each light fixture.

.11 Avoid interference with, and provide clearance for, the equipment. Where the indicated locations for the lighting fixtures conflict with the locations for other equipment, change the locations for the lighting fixtures by the minimum distances necessary and as approved by the Consultant.

.12 Where fixtures are specified to have two separate power sources within, provide all necessary barriers, etc., to isolate the two power sources as per the requirements of the authorities having jurisdiction.

.2 Pendant Mounted:

.1 Space single stem hangers or suspension cables, on continuous row luminaires as per Manufacturer recommended specifications.

.2 Provide twin stem hangers or suspension cable, on single luminaires.

.3 Aircraft Cable Support shall use cable, anchorages, and intermediate supports recommended by luminaire Manufacturer.

.4 Not all lighting appurtenances such as outlet box locations are shown on Drawings. Position outlet boxes to coincide with suspension hangers and knockouts.

.5 For suspended lighting fixtures, provide the indicated mounting height clearances between the bottoms of the fixtures and the finished floors.

.3 Swinging Type: Provide, at each support, safety cable capable of supporting four times the vertical load from structure to luminaire.

.1 Brace suspended luminaires installed near ducts or other elements so that they do not swing into obstructions.

.4 Finished Areas:

.1 Install symmetrically with tile pattern.

.2 Locate with centerlines either on centerline of tile or on joint between adjacent tile runs.

.3 Install recessed luminaires tight to finished surface such that no spill light will show between ceilings and trims.

.4 Combustible Low Density Cellulose Fiberboard: Provide spacers and mount luminaires 38mm from ceiling surface or use fixtures suitable for mounting on low density ceilings.

.5 Junction Boxes:

.1 Flush and Recessed Luminaires: Locate a minimum of 300mm from luminaire.

.2 In concealed locations, install junction boxes to be accessible by removing luminaire.

.3 For remote mounted junction boxes, refer to luminaire schedule and Drawings.

.6 Wiring and Conduit:

.1 Provide wiring of temperature rating required by luminaire.

.2 Provide flexible steel conduit.

.7 Provide plaster frames when required by ceiling construction.

.8 Independent Supports:

.1 Provide each recessed luminaire with two safety chains or two No. 12 soft annealed galvanized steel wires of length needed to secure luminaire to building structure independent of ceiling structure.

.2 Tensile strength of chain or wire, and method of fastening to structure shall be adequate to support weight of luminaire.
.3 Fasten chain or wire to each end of luminaire.

.5 Unfinished Areas: Locate luminaires to avoid conflict with other building systems or blockage of luminaire light output.
.1 Fixture Suspension: Provide threaded steel hanger rods or wires. Scissor type hangers not permitted.
.2 Rod Hangers shall be 3/16” minimum diameter, cadmium-plated threaded steel rod.
.3 Wires shall be ASTM A 641/A 641M, Class 3, soft temper, zinc coated steel, 12 gauge.
.4 Wires for humid spaces shall be ASTM A 580/A 580M, composition 302 or 304, annealed stainless steel, 12 gauge.
.5 Attachment to Steel Beams: Provide flanged beam clips and straight or angled hangers.
.6 Hang independent of pipes and ducts.

.6 Building Exterior: Flush mounted back box and concealed conduit, unless otherwise indicated in the Contract Documents.

3.2 LED CHIPSETS

.1 Provide in each fixture, number and type for which fixture is designed.

3.3 DRIVERS

.1 Factory installed by the fixture Manufacturer.

.2 Replace noisy or defective drivers.

3.4 LIGHTING CONTROL

.1 Occupancy Sensors: Locate and aim sensors to achieve best coverage of controlled areas per the Manufacturer’s recommendations.

.2 Photocell sensors: Locate and aim sensors according sensor type and according to Manufacturer's recommendations.

.3 Coordinate, receive, mount, connect, configure all equipment.

.4 Install equipment in accordance with Manufacturer’s installation instructions.

.5 Provide complete installation of system in accordance with Contract Documents.

.6 Maintain performance criteria stated by the Manufacturer without defects, damage, or failure.

.7 Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.

.8 Ensure that daylight sensor placement minimizes sensors view of electric light sources; ceiling mounted, and fixture-mounted daylight sensors shall not have direct view of luminaries.

.9 Furnish all conduit, wire, connectors, hardware, and other incidental items necessary for a properly functioning lighting control and relay system as

described herein and shown on the plans. The Electrical Contractor shall maintain performance criteria stated by the Manufacturer without defects, damage, or failure.

.10 Compliance: Contractor shall comply with Manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.

.11 Circuit Testing: The contractor shall test that all branch load circuits are operational before connecting loads to system load terminals, and then de-energize all circuits before installation.

3.5 TESTING

.1 The luminaires shall be properly tested with the lighting controls to ensure proper operation, zones, scenes, emergency operation, dusk/dawn signals, and other control settings.

.2 Malfunctioning Luminaires and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

3.6 CLEANING

.1 Remove labels and markings, except ULC or CSA listing mark.

.2 Wipe luminaires inside and out to remove construction dust.

.3 Clean luminaire plastic lenses with antistatic cleaners only.

.4 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01 74 00.

.5 Touch up painted surfaces of luminaires and poles with matching paint ordered from manufacturer.

.6 Replace defective components at time of Substantial Performance of the Work.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

.1 Unless otherwise indicated, lighting fixture bodies shall be of minimum 20 gauge cold rolled prime steel of rigid construction with knockouts as required.

.2 Any feature architectural luminaire, surface, or pendent mounted shall be manufactured from extruded aluminum.

.3 Fixture rigidity shall permit any suspension method without sag. Fluorescent fixtures shall be suitable for either individual or continuous mounting.

.4 Any luminaire requiring a continuous luminous appearance must be coordinated with the Consultants prior to manufacturing. Consultants must provide custom specifications (lengths) to manufacturer. Luminaire shall be installed as a single “system.”

.5 Fixtures shall be finished in baked white enamel with exposed surfaces matching the exposed T-bar ceiling specified in other Sections and shall resist chipping, corrosion, and discolouration. Before finishing, all metal shall be chemically degreased and neutralized. Finish shall not be less than two coats of enamel, sprayed and baked on. Reflecting surfaces shall be white with an average reflectance of not less than 85%.

.6 Fixture lenses and diffusers shall be rigid enough to be self-supporting without sag, easily removable but not loose. Provide additional thickness of lens to prevent sag at no extra cost to the Owner.

.7 Where the Architect is to select colours and finish of lighting fixtures after award of Contract, it shall be the responsibility of the Contractor for Division 26 to obtain this information during the shop drawing submittal/review stage.

.8 Where fixtures are specified to have two separate power sources within, provide all necessary barriers, etc., to isolate the two power sources as per the requirements of the authorities having jurisdiction.

2 Products

2.1 FIXTURES

.1 Refer to drawings and– Lighting Schedules

3 Execution

3.1 INSTALLATION

.1 Any luminaire installed into a drywall ceiling must be accessible from below the ceiling for maintenance, including changing lamps, ballasts, LED modules, and LED drivers.

.2 All LED luminaires shall be composed of modular components for future maintenance by building staff. This includes replaceable LED driver and LED (printed circuit board, LED light bar, or LED module.)

.3 Any luminaire having a ridged lens shall be oriented where the ridge is on the interior of the luminaire and the exterior surface of the luminaire is smooth for ease of maintenance.

.4 Any suspended indirect luminaire with an uplight component shall be complete with a clear lens on top for ease of maintenance. Open top luminaires are not permitted.

.5 All luminaires intended for use in exterior locations or wet interior locations shall be gasketted and CUL listed for wet locations.

.6 All luminaires intended for use in exterior locations shall be liquid ingress protection (IP) rated at a minimum of IP65.

.7 All luminaires intended for use in exterior locations shall be fused. Pole mounted luminaires are excluded from this requirement if a fuse kit is installed in an accessible hand well in the pole.

.8 All exterior luminaires shall be constructed to emit zero light above the horizontal. Ensure the IES BUG Rating U = 0.

.9 All luminaires intended to be used in a corrosive environment (i.e., natatorium) shall be finished with a polyester powder coat.

.10 All Luminaires shall be installed accurately in line and level. Co-ordinate this work with other trades to ensure that their work is not held up by the work of this Contract and that the luminaires are installed on schedule.

.11 All luminaires shall be installed in the standard manner for the type of luminaire and in accordance with the Manufacturer's instructions. Luminaire studs or other equally secure methods of attachment shall be used throughout or as called for in the Luminaire Schedule.

.12 The Contractor shall be responsible for checking the ceilings finishes in all areas where recessed luminaires are being installed to ensure that the luminaires which are ordered for these areas are purchased with suitable ceiling trim for the particular ceiling finish. Luminaires which are sent to the site with the wrong ceiling trim or flanges shall be replaced with luminaires having the correct trims without additional cost to the Owner. The Contractor shall notify the Project Manager if the ceilings are improperly installed and shall be guided by his decisions before proceeding with the luminaire installation.

.13 Plaster frames and rings shall be provided for luminaires recessed in plaster ceilings. The installation of the plaster ring shall be done by a Lathing Trade Contractor under the supervision of the Contactor for Division 26 to ensure that they are located correctly.

.14 The Contractor for Division 26 shall include a dry wall mounting kit for any recessed luminaire installed in a drywall ceiling.

.15 The Contractor for Division 26 shall coordinate the installation of any recessed luminaire labeled as 'flangeless' with the Drywall Contractor.

.16 Luminaires shall be properly cleaned at the time of installation. Any luminaires showing marks or scratches due to handling or installation shall be replaced without additional cost to the Owner.

.17 Luminaires in service areas, mechanical, and electrical rooms shall be installed after the mechanical and electrical equipment is in place. The fixtures shall be located on-site to clear all obstructions and to facilitate lamp removal, to the approval of the Owner.

.18 Luminaires and accessories shall not be fixed to or suspended in any way from mechanical pipes, ducts, or other components. If necessary, additional supports shall be installed to bridge the equipment.

.19 All luminaires which are located in suspended ceilings shall be supported by approved wires or chains which will allow the luminaire to be supported properly and independent of the ceiling system. All supports shall be provided by this Contract.

.20 Provide luminaire mock-ups as detailed in the luminaire schedule. No luminaire shall be put into manufacture until Consultants and Project Manager's approval is received. Coordinate time with Consultant and Owner to view mock-up.

.21 Where luminaires are mounted on wiring channels or assemblies provide necessary barrier to isolate dual power sources.

END OF SECTION

1 General

1.1 Related Sections

.1 Section 26 05 00
.2 Conform to relevant Sections of the Specifications for Division 26 and all other Divisions.

1.2 Product Data

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

.2 Data to indicate system components, mounting method, source of power and special attachments.

2 Products

2.1 EQUIPMENT

.1 Supply voltage: 120 V, ac.

.2 Output voltage: 24 V dc.

.3 Operating time: 30 min. Battery: sealed, maintenance free.

.4 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of +/- 0.01 V for +/- 10% input variations.

.5 Solid state transfer circuit.

.6 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

.7 Signal lights: solid state, for ['AC Power ON'] and ['High Charge'].

.8 Lamp heads: integral on unit or remote, 345 horizontal and 180 vertical adjustment. Lamp type: solid state, 6W.

.9 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.

.10 Auxiliary equipment:
- .1 Ammeter.
- .2 Voltmeter.
- .3 Test switch.
- .4 Time delay relay.
- .5 Battery disconnect device.
- .6 Ac input and dc output terminal blocks inside cabinet.
- .7 Shelf.
- .8 Cord and single twist-lock plug connection for ac.
- .9 RFI suppressors.

2.2 WIRING OF REMOTE HEADS

.1 Conduit: type: to Section 26 05 34.

.2 Conductors: to Section 26 05 21 – Wires and Cables (0 - 1000V), sized.

3 Execution

3.1 INSTALLATION

.1 Install unit equipment and remote mounted fixtures.

.2 Direct heads.

.3 Connect exit lights to unit equipment.

END OF SECTION

EXIT SIGNS

1 General

1.1 REFERENCE

.1 Section 26 05 00
.2 Conform to relevant Sections of the Specifications for Division 26 and all other Divisions.

1.2 RELATED WORK

.1 Comply with relevant Sections of this and other Divisions of this Specification.

1.3 PRODUCT DATA

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

.2 Exit Signs based on CSA C22.2 No141

.3 NRCAN/CSA C860 Certified.

2 Products

2.1 GENERAL AREAS - TYPE X

.1 Thin line type with a maximum depth of 51mm (2"), surface, single or double face, end or ceiling mounted.

.2 Housing to be die-cast aluminum.

.3 Faceplate to be green running man pictorial sign complying to NBC 20 12 stand and with or without directional indicators as required.

.4 Lamps to be high output LED not exceeding 2W power draw, vertically aligned, and parallel proprietary lateral, acrylic lens, such that they are fully contained and not be visible or protruding.

.5 Pictorial exit sign shall be Lumacell – LD series or approved equal.

2.2 GENERAL

.1 All exit lights shall have:
  .1 Have no light leakage from joints and fittings.
  .2 Have canopy and/or stem hangers to match housing.
  .3 Meet the requirements of standard CSA C860.
  .4 Must be 2010 NBC compliant.

3 Execution

3.1 INSTALLATION

.1 Install exit lights at locations indicated in the Contract Documents and as required.

.2 Exit signs to be 120VAC (normal) and DC (emergency) powered from nearest unit equipment.

.3 Connect exit lights to circuits as indicated.

.4 Ensure that exit light circuit breaker is locked in ON position. Unless otherwise specified, all lighting fixtures are of the quality stated in Manufacturer's catalogue and specifications. Furnish fixtures with suitable support to suit the area in which they are installed. Leaving lighting fixtures with all glassware, lamps, etc. thoroughly cleaned and hangers and metal parts brightly polished where applicable.

.5 Install exit signs to Manufacturer's recommendations, listing requirements, NFPA standard, and local regulatory requirements.

.6 Ensure that nowhere, are exit lights mounted less than 2m (6'-6") between underside of unit and finished floor.

.7 For ceiling mounting in areas with unfinished ceiling, mount unit alongside junction box, with or without canopy, and supply unit laterally with conduit (or with buried conduit, where allowed or specified, or by using the exit light canopy as a junction box where approved).

.8 Mount all fixtures and accurately in line and level. Any fixtures which, in opinion of the Owner, are not installed properly must be taken down and re-installed to the satisfaction Owner.

END OF SECTION

1 General

1.1 GENERAL

.1 Follow the Contract Drawings for the scope of supply/work.

.2 All conditions of the Contract apply to the work of this Section.

1.2 RELATED WORK

.1 Section 26 05 00.

1.3 REFERENCES

.1 CSA C22.1-12 - Ontario Electrical Safety Code

.2 CSA C22.2 NO. 46-13 - Electric air-heaters

.3 CSA C828-13 - Performance requirements for thermostats used with individual room electric space heating devices.

1.4 SYSTEM DESCRIPTION

.1 Provide electric heating equipment including electric heating appliances and control devices as shown on the drawings and as described in this Specification.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 26 05 00 and the requirements of Division 1.

.2 Label equipment on shop drawings according to the equipment designations from the Drawings.

1.6 WARRANTY

.1 Provide a 1 year Manufacturer's warranty on all products to be free of Manufacturers' defects.

2 Products

2.1 MANUFACTURER

.1 As indicated in Contract Drawings and/or Stelpro, Ouellet or approved equivalent.

2.2 ELECTRIC SLOPED TOP BASEBOARD HEATER

.1 Construction
- .1 As indicated in Contract Drawings.
- .2 18-gauge steel cabinet.
- .3 16-gauge steel front cover.
- .4 Interior parts protected by louvered grille. Pencil proof openings less than ¼" (6.4mm).
- .5 Linear high-limit temperature control with automatic reset.
- .6 Full length built-in wireway.

.2 Heating element
- .1 Stainless steel tubular heating element with aluminum fins.
- .2 Floating elements on high-temperature nylon bushings eliminating expansion noises.

.3 Watt density
- .1 Average standard watt density of 275W/ft. (900W/m).
- .2 Refer to Contract Drawings for required wattage of individual units.

.4 Control
- .1 Built-in tamperproof thermostat.

.5 Finish
- .1 Standard: epoxy/polyester powder paint.
- .2 Colour to be confirmed by shop drawing submission.

.6 Voltage
- .1 As indicated in Contract Drawings.

.7 Ouellet OPR series or equivalent.

2.3 ELECTRIC FAN FORCED HEATER

.1 Construction
- .1 As indicated in Contract Drawings.
- .2 Extruded aluminum front grille.
- .3 Bottom air outlet.
- .4 High-limit temperature control with automatic reset.
- .5 Provide surface mounting box where required (refer to Drawings).

.2 Heating element
- .1 Tubular heating element with aluminum fins.

.3 Fan
- .1 Sealed, factory lubricated motor.
- .2 160cfm fan.
- .3 Fan delay to purge heater of residual heat.

.4 Control
- .1 Built-in tamperproof thermostat.

.5 Finish
- .1 Standard: epoxy/polyester powder paint.
- .2 Colour to be confirmed by shop drawing submission.

.6 Voltage
- .1 As indicated in Contract Drawings.

.7 Ouellet OAWH series or approved equivalent.

2.4 ELECTRIC UNIT HEATER

.1 Construction
- .1 As indicated in Contract Drawings.
- .2 18- and 20-gauge steel.
- .3 Adjustable louvers to direct air flow.
- .4 High-limit temperature control with automatic reset.

.2 Heating element
.1 Stainless steel tubular heating element.

.3 Fan
.1 As indicated in Contract Drawings.
.2 Thermally protected motor.
.3 Motor mounted in cold compartment.
.4 Totally enclosed and factory lubricated ball bearing motor.
.5 <35dBA fan.
.6 Fan delay to purge heater of residual heat.

.4 Control
.1 Built-in contactor.
.2 Remote thermostat control.

.5 Finish
.1 Standard: epoxy/polyester powder paint.

.6 Voltage
.1 As indicated in Contract Drawings.

.7 Mounting/Installation
.1 Horizontal wall or ceiling mounting using one of two supplied brackets which allow 360° rotation.
.2 Vertical mounting using 4 threaded rods ½" x 13 UNC (not included).

.8 Ouellet OAS series or equivalent.

2.5 THERMOSTAT

.1 Provide non-programmable line voltage electronic thermostat for control of unit heater.

.2 Voltage
.1 120/208/240V, 50/60 Hz or as indicated in Drawings.

.3 Control
.1 Precision: ± 0.5°C.

.4 Temperature rise
.1 5°C to 27°C.

.5 Setting
.1 Celsius version available only.

3 Execution

3.1 INSTALLATION

.1 Install heater units in locations as indicated on the Drawings centering the units in spaces whenever possible.

.2 Fasten heater units securely to the structural elements.

.3 Install heater units after painting and floor finishes are completed.

.4 Provide proper back box for surface mounted or recessed fan-forced units and securely fasten to the structural members. Locate units to avoid swinging doors and creating obstructions in corridors and walkways.

3.2 FIELD QUALITY CONTROL

.1 At final inspection, provide spot tests to demonstrate that equipment is functional.

.2 Touch up all damaged paint to heater units as directed by the Owner/Consultant.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 This Section specifies the basic requirements for communications installations as indicated or required and includes requirements common to more than one Specification Section of this Division (such as related documents, related Sections, definitions, governing requirements, Contractor requirements, warranty requirements, submittal requirements/procedures, and project closeout requirements/procedures, as well as other requirements). This Section may expand upon and/or supplement the requirements specified in other Divisions including but not limited to 01, 26, 28.

.2 Examine the Contract Documents in their entirety for requirements or work which may affect work under this Section, regardless of whether such requirements or work are specifically indicated in this Section.

.3 Where noted, the term “Owner’s Representative” shall include, but is not limited to, City staff, Consultant’s Engineer of Record or Architect or appointed representative, City appointed Construction Supervisor/Administrator.

.4 Related Sections:
- .1 Division 01
- .2 Section 07 84 00
- .3 Section 26 05 28
- .4 Section 26 05 34

1.2 REFERENCE STANDARDS

.1 ANSI/TIA 568 series, most recent revisions, addenda and systems bulletins. All applicable.

.2 ANSI/TIA–569 Telecommunications Pathways and Spaces, most recent revision including all relevant addenda and systems bulletins.

.3 ANSI/TIA–606 Administration Standard for Telecommunications Infrastructure, most recent revision including all addenda and systems bulletins.

.4 ANSI/TIA–607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises, most recent revision including all addenda and systems bulletins.

.5 ANSI/TIA–862 Structured Cabling Infrastructure Standard for Intelligent Building Systems, most recent revision including all addenda and systems bulletins.

.6 ANSI/TIA–942 Telecommunications Infrastructure Standard for Data Centers, most recent revision including all addenda and systems bulletins.

.7 ANSI/TIA–1179 Healthcare Facility Telecommunications Infrastructure Standard, most recent revision including all addenda and systems bulletins.

.8 ANSI/TIA–4966 Telecommunications Infrastructure Standard for Educational Facilities, most recent revision including all addenda and systems bulletins.

.9 TIA–TSB–162 Telecommunications Cabling Guidelines for Wireless Access Points, most recent revision including all addenda and systems bulletins.

.10 TIA/TSB-184-A Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling.

.11 BICSI, Telecommunications Distribution Methods Manual, most recent edition.

.12 Information Transport Systems Installation Methods Manual (ITSIMM), most recent edition.

.13 National Electric Codes (NEC) – all applicable.

.14 OSHA Standards and Regulations – all applicable.

.15 Local Codes and Standards – all applicable.

.16 UL444 – Standard for Safety of Communications Cable.

.17 UL 1666 – Standard for Safety of Flame Propagation Height.

.18 Local Authority Having Jurisdiction (AHJ).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit Manufacturer's instructions, printed product literature and data sheets for communications equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit Overall Floor Plans: floor and site plans showing the locations of devices and cable routing paths with cable types and quantity called out.

.4 Wiring diagrams.

.5 Rack Elevation Drawings.

.6 Provide all applicable portions of the following information, in addition to the standard requirements, within 7 days after receiving each reel and/or box of cable:

.1 Manufacturer’s product test data for fiber optic cable components.

.2 Visually inspect Category–6A UTP. Materials cannot be used before results have been submitted to CM and approved by the Owner or its representative.

.3 On–reel OTDR testing of all fiber.

.7 Provide all applicable portions of the following completed test documentation in addition to the standard requirements, within 10 days after completion of the tests for each cable channel or link:

.1 Test reports shall be submitted in the following manner:

.1 To the Owner: One copy on 8.5” x 11” papers providing for quality reproducible printing, and electronic copy in MS Excel format.

.2 Submit test report documentation through CM for review by the Engineer for Specification conformance and one copy in electronic format.

.2 Twisted–pair field test documentation.

1.4 QUALITY ASSURANCE

.1 Manufacturer's Warranty
  .1 Contractor shall provide Warranty on all copper and fiber links and/or channels meeting the following criteria:
    .1 A 25 year guarantee that the installed cabling system will pass the Commercial Building Telecommunications Standards cited in this document.
    .2 This warranty will cover all registered links and/or channels.
  .2 Contractor shall indicate in warranty documentation whether registered links are to be link or channel.
  .3 The communications Contractor will correct any problems and malfunctions that are warranty–related issues without charge for the entire warranty period.

.2 Testing and Inspection of Communications Equipment
  .1 Provide tests specified below, when applicable, and as indicated under individual items of material, equipment, and work specified in this Specification.
    .1 Furnish all test equipment and instruments required for the tests.
    .2 Responsible, qualified employees of the Contractor in the presence of the Owner or an authorized representative shall perform the cable testing.
    .3 All individuals involved in the testing phase of the project shall not have been involved in the installation phase nor shall have immediate knowledge of the installation task.
    .4 End to end performance of all parts and channels will be tested.

1.5 RESPONSIBILITIES AND COORDINATION

.1 The Contractor shall provide all materials, qualified labor and services required to ensure a complete and operational system, installed in accordance with the intent of the Contract Documents.

.2 The Contractor shall furnish and install all incidental items not actually shown or specified, but which are required by best practices to provide complete functional systems.

.3 The Contractor shall coordinate the details of facility equipment and construction for all Specification Divisions, which affect the work covered under this Division.

.4 The Contractor shall coordinate all activities with the overall construction schedule.

.5 The Contractor shall develop a bill of materials, perform material management and efficient use of the materials whether they are issued by Owner or purchased by the Contractor.

.6 The Contractor shall ensure materials, in excess of, those required to complete the project are kept in their original condition and packaging for restocking.

1.6 DESIGN CRITERIA

.1 Compliance by the Contractor with the provisions of this Specification does not relieve him or her from the responsibilities of providing materials and equipment

of proper design, mechanically and electrically suited to meet operating requirements at the specified service conditions.

.2 The following are incorporated into the design:
.1 The intent of the Drawings is to restrict the maximum horizontal subsystem cabling length to 295’ for all horizontal cabling.

1.7 LABELLING

.1 Comply with latest TIA/EIA–606 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

.2 Refer to Section 26 05 00.

.3 Coordinate all labelling requirements with Owner’s Facilities and IT Departments for review and approval.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 and with Manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials in dry location, indoors and in accordance with Manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect communications equipment from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

2 Products

2.1 GENERAL

.1 Conduits: in accordance with Section 26 05 34.

.2 Junction boxes, cabinets type: in accordance with Section 26 05 31.

.3 Outlet boxes: Conduit boxes size and fittings shall be in accordance with Section 26 05 31.

.4 Communications outlets shall have as a minimum, a 4-11/16” square x 4” deep junction box with single-gang trim ring and a 1” conduit with insulated bushing stubbed up to an accessible ceiling space.

.5 Fish-wire: polypropylene type.

.6 J-hooks approved manufacturer: Caddy CableCat or approved equivalent.

.7 J-hooks shall only be utilized in secure areas and accessible ceiling spaces and/or as noted on Drawings. J-hooks shall be utilized from stub up conduit locations to route cabling to cable trays, where cable trays are shown.

.8 Include for all structural support required for the installation of conduits and j-hooks.

.9 Approved Manufacturer:
- .1 Panduit
- .2 Belden
- .3 Or approved equal

3 Execution

3.1 INSTALLATION

.1 Install an empty raceway system, including overhead distribution system, fish-wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable troughs, service poles, miscellaneous and positioning material to constitute the complete system.

.2 Ensure to follow Manufacturer's instructions and specifications.

.3 All conduits and cable trays to be properly grounded.

.4 Ensure structural loading requirements are met.

.5 Ensure that all cabling pathways are free of sharp corners, edges or bends.

.6 Conduit runs shall not exceed 33m (100') without a pull box. Conduit runs shall have no more than two 90° bends between pull boxes and/or conduit ends.

.7 Pull boxes shall not be used as a means to change directions of conduit runs.

.8 Provide a minimum of 300mm (12") vertical clearance above cable trays. Ensure that cable tray is not inaccessible due to interferences with other systems, such as HVAC, piping and lighting, for extended lengths.

.9 Cable tray supports shall be installed on either side of the cable tray sections and shall not be installed more than 10' apart for each span.

.10 Non-continuous pathways (i.e., j-hooks) shall keep crossover to a minimum and shall be routed to follow parallel and perpendicular paths to the building structure.

.11 J-hooks shall be attached to building structure and framework only and shall be spaced a maximum of 5' apart.

3.2 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for communications equipment installation in accordance with Manufacturer's written instructions.

3.3 WORKMANSHIP

.1 Manufactured products, materials, equipment, and components shall be provided, conditioned, applied, installed, connected, and tested in accordance with the Manufacturer's specifications and printed instructions.

.2 The installation of all system components shall be carried out under the direction of qualified personnel. Appearance shall be considered as important as mechanical and electrical efficiency. Workmanship shall meet or exceed industry standards.

3.4 INTENT OF DRAWINGS

.1 The Drawings show only general locations of equipment, devices, raceways, cable trays, boxes, etc., unless specifically dimensioned.

.2 The Contractor shall be responsible for the proper placement and routing of equipment, cable, raceways, cable runway, and related components, according to the Contract Documents and subject to prior review by the Owner's Representative.

.3 The Contractor shall refer any conflicts within the Contract Documents to the Owner's Representative for resolution.

.4 Follow as closely as practicable the schematic design shown on the Drawings. Make all necessary measurements in the field to verify exact locations and ensure precise location and fit of specified items in accordance with the Drawings. Make no substantial alterations without prior approval of the Owner's Representative.

3.5 GROUNDING

.1 Comply with requirements in Section 26 05 28, for grounding conductors and connectors.

.2 Comply with ANSI/TIA–607 and the Ontario Electrical Safety Code.

3.6 FIRESTOPPING

.1 Comply with requirements in the Ontario Building Code and the Ontario Electrical Safety Code.

.2 Comply with Section 07 84 00.

3.7 SERVICE CONTINUITY

.1 Maintain continuity of communications services to all functioning portions of the process or buildings during hours of normal use.

.2 Arrange temporary outages for cutover work with Owner. Keep outages to a minimum number and a minimum length of time in order to provide minimum impact.

3.8 TESTING AND INSPECTION OF COMMUNICATIONS EQUIPMENT

.1 Provide tests specified in following subsections below, when applicable, and as indicated under individual items of material, equipment, and work specified in this Specification.

- .1 Furnish all test equipment and instruments required for the tests.
- .2 Responsible, qualified employees of the Contractor in the presence of the Owner or an authorized representative shall perform the cable testing.
- .3 All individuals involved in the testing phase of the project shall not have been involved in the installation phase nor shall have immediate knowledge of the installation task.

3.9 CABLE TERMINATIONS AND TEST PLANS

.1 General
- .1 Provide proof of Testing Technician(s) certification for operation of the specific units of test equipment, which are proposed for use.
- .2 The Contractor shall obtain Owner's Representative's approval for each termination and test plan prior to execution of the work.
- .3 This Section covers work necessary to furnish communications system testing, including the following:
  - .1 Outside Plant (OSP) Cabling Infrastructure (Campus LAN/WAN extension)
  - .2 Back–Bone Cabling Infrastructure
  - .3 Horizontal Cabling Systems
- .4 Inspection Requirements:
  - .1 As part of any performance test, inspect cable, material, and equipment for physical damage, continuity, and proper connection.
  - .2 Verify identification and labeling at required locations for visibility, condition, legibility, and accuracy.
- .5 Test Report Requirements – Each test report shall include the following sections:
  - .1 Scope of testing.
  - .2 List of equipment used in the test with a photocopy of the factory calibration certificate.
  - .3 List of technicians performing the tests identified in the scope of testing.
  - .4 Summary of test results: Hardcopy and electronic copies of the summary forms are to be delivered at conclusion of the project before final payment will be made.
  - .5 Individual test data sheets: The individual test data sheets shall be developed and completed by the Contractor. Formatted output from cable scanners is typically acceptable provided they contain all of the test parameters including graphs of the information required by this Section.

.2 Cable Termination Plans
- .1 Submit detailed termination plans for both fiber optic and twisted pair cables, which describe how each system component will be installed and terminated.

.3 Cable Test Plans
- .1 Submit detailed test plans for both fiber optic and twisted–pair cable channels which include at least the following information:
  - .1 Describe the tests to be performed.
  - .2 Explain when and how each system component will be tested.
  - .3 List the test equipment to be used.
  - .4 Itemize how theoretical loss budgets and test parameters will be calculated and listed.
  - .5 Provide an example of the test reporting documentation for each type of test, which provides a written verification of the results, as required in paragraph 2 below.
- .2 Provide testing documentation which includes:
  - .1 Dates and times of test

.2 Personnel performing tests
.3 Initial test results
.4 Description of discrepancies found or failure, if any
.5 Corrective action, if any
.6 Date and person performing corrections
.7 Retest results, if required
.8 Include space for Owner's sign–off
.9 Copy of test equipment calibration certificates
.10 Intrabuilding (Vertical and Horizontal Subsystem) fiber optic segment post–installation test plan

.3 Twisted–Pair Cable Tests: Testing shall be performed using a minimum level IIIe tester, approved by the Engineer.

.4 Twisted–Pair Test Plans: Provide separate post–installation test schemes for the following activities:
.1 Backbone Subsystem twisted–pair segment test plan.
.2 Horizontal Subsystem twisted–pair segment test plan.

.5 Fiber–Optic Cable Tests: Testing shall be performed using a level IIIe tester, with approved test–heads approved by the Engineer.

.6 Fiber–Optic Test Plans: Provide separate post–installation test schemes for the following activities:
.1 Backbone subsystem fiber–optic segment test plan.
.2 Horizontal subsystem fiber–optic segment test plan.

3.10 FINAL TEST AND ADJUSTMENT

.1 The Contractor shall be responsible for post–installation performance testing of all cabling systems specified elsewhere in this Section of the Contract Documents.
.1 Testing procedures shall permit recording the length of each link, theoretical loss budget, and tested parameters for each pair and fiber, including space for sign–off by Owner's Representative.
.2 Any cable links or fiber strands, which fail to meet performance test criteria, shall be re–terminated, re–connectorized, or replaced by the Contractor free of charge.
.3 Submit final field test documentation in list form for Owner's Representative's approval.

.2 Unshielded Twisted–Pair Cable System Testing
.1 Permanent Link Test Configuration: Perform metered tests on each multi–pair twisted–pair and/or four–pair UTP cable through the wiring block, patch panel, at each end of the cable section and/or telecommunication outlet (T.O.). The permanent link test shall be undertaken as described in ANSI/TIA–568–C.2–1.
.2 Performance Testing:
.1 Horizontal Cable System:
.1 Use a minimum Level IIIe field test instruments capable of the following swept/stepped frequency voltage measurements in accordance with the performance parameters required by ANSI/TIA–568–C.2–1.

.2 Test each horizontal link to verify/determine, wire map, length, attenuation, skew, and near–end–cross–talk (NEXT) as described in ANSI/TIA–568–C.2–1.

.3 Additional testing for PoE/PoE+ per Manufacturer's requirements including but not limited to resistance unbalance and point to point resistance unbalance;

.3 Test Reports: Include field test results for each cable including cable link length in accordance with ANSI/TIA–568–C.2–1.

.4 The test summary shall include:

.1 Cable Identification as it appears on cable schedule.

.2 Cable identification as it appears on the individual test reports.

.3 Cable identification as it is labeled in accordance with the Specifications.

.4 Pass/Fail Status.

.5 All test parameters shall appear on each test document including graphics and indicating each test parameter result.

.6 The individual test data sheet shall include the automated print out produced by the cable scanning equipment.

3.11 CONSTRUCTION REVIEW

.1 The Owner's Representative will review and observe installation work to ensure compliance by the Contractor with requirements of the Contract Documents.

.2 The Contractor shall inspect, and test completed communications installations to demonstrate specified performance levels including the following:

.1 Furnish all instruments and personnel required for the inspections and tests.

.2 Perform tests in the presence of the Owner's Representative.

.3 Demonstrate that the system components operate in accordance with the Contract Documents.

.3 Review, observation, assistance, and actions by the Owner's Representative shall not be construed as undertaking supervisory control of the work or of methods and means employed by the Contractor. The Owner's Representative's review and observation activities shall not relieve the Contractor from the responsibilities of these Contract Documents.

.4 The fact that the Owner's Representative does not make early discovery of faulty or omitted work shall not bar the Owner from subsequently rejecting this work and withholding payment until the Contractor makes the necessary corrections.

.5 Regardless of when discovery and rejection are made, and regardless of when the Contractor is ordered to correct such work, the Contractor shall have no claim against the Owner's Representative for an increase in the Subcontract Price, or for any payment on account of increased cost, damage, or loss.

3.12 PROJECT RECORD DOCUMENTS

.1 Provide detailed project record documentation for sections listed in paragraph 1.1.3 above, in addition to the standard requirements, within 30 days after completion of the work.

.2 Maintain separate sets of redlined record drawings for the communications work, which show the exact placement, and identification of as–built system components. These are subject to weekly review by the Owner's representative.

.3 Provide communication room record drawings, if applicable, which indicate exact placement for all components; e.g., conduit, wireway, cable tray, backboards, equipment cabinets, equipment racks, and cross–connect equipment, etc.

.4 Provide communication wiring and cabling record drawings and schedules which indicate exact placement, routing, and connection details for all components, e.g., twisted–pair cables, splices, cable cross–connect termination locations, enclosures, telecommunications outlets, and cross–connect jumpers, patch cords, etc.

.5 Provide network schematics when appropriate.

.6 Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

.7 Cabling Administration Drawings: Show building floor plans with cabling administration–point labeling. Identify labeling convention and show labels for telecom spaces, backbone pathways and cables, entrance pathways and cables.

3.13 CONTRACTOR'S REQUIREMENTS

.1 Contractor shall furnish current certifications for deployment of structured cabling solutions and furnish a copy of the current Manufacturer certification with all bids.

.2 Contractor shall have at least 5 years documented experience installing and testing structured cabling systems of similar type and size.

.3 Contractor shall employ at least one BICSI Registered Communication Distribution Designer (RCDD).

.4 Contractor shall have all necessary permits, licenses, and inspections required for the performance of data, voice, and fiber optic cable installations.

.5 Contractor's Technicians shall be currently certified for installation of low voltage copper systems and fiber distribution systems.

.6 Ensure conformance with all Contract and warranty provisions.

.7 Confirmation of Pathway sizing:

- .1 Wherever cabling pathways are installed, it is the Contractor's responsibility to confirm pathway or manager sizing to represent no more than 25% fill upon installation according to Manufacturer's fill tables.
- .2 Pathways deemed overfilled upon installation will not be accepted and shall be remedied at Contractor expense.

3.14 CLEANING

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

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

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

.3 No tools or materials shall be left in a manner as to pose a safety hazard.

.4 Contractor shall remove all abandoned cable per TIA and BICSI standards, recycling these materials where possible.

3.15 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by communications equipment installation.

END OF SECTION

1 General

1.1 GENERAL

.1 All conditions of the Contract apply to the work of this Section.

1.2 RELATED WORK

.1 Section 26 05 00.

.2 Prior to the commencement of work, the Contractor shall obtain all permits necessary for installation of the work. All permit costs and inspection fees shall be included as part of the required work.

.3 Local requirements shall be adhered to with regard to submitting Specifications, wiring diagrams, shop drawings and plans. Responsibility for furnishing the quantities of copies on cloth and/or paper, as directed by such requirements, shall be included as part of the work of this Section.

.4 Prior to commencement and after completion of work, the Contractor shall notify all authorities having jurisdiction.

.5 The Contractor shall submit a letter of approval of the installation, from the local code authority, before requesting final acceptance of the system.

1.3 REFERENCES

.1 Ontario Electrical Safety Code

.2 Ontario Building Code

.3 Ontario Fire Code

.4 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S524-06, Standard for the Installation of Fire Alarm Systems.
.2 CAN/ULC-S525-07, Audible Signal Device for Fire Alarm Systems.
.3 CAN/ULC-S526-07, Visual Signal Devices for Fire Alarm Systems.
.4 CAN/ULC-S527-11, Control Units.
.5 CAN/ULC-S528-05, Manual Pull Stations for Fire Alarm Systems.
.6 CAN/ULC-S529-09, Smoke Detectors for Fire Alarm Systems.
.7 CAN/ULC-S530 R1999, Heat Actuated Fire Detectors for Fire Alarm Systems.
.8 CAN/ULC-S536-04, Standard for the Inspection and Testing of Fire Alarm Systems.
.9 CAN/ULC-S537-04, Standard for the Verification of Fire Alarm Systems.

1.4 SUMMARY NETWORK FIRE ALARM CONTROL PANEL (NODE)

.1 Network fire alarm control panels shall include all features as described in this Specification for stand-alone FACP's and shall have network communication capabilities as described herein.

.1 All points monitored and controlled by a single node shall be capable of being programmed as "Public". Each point made public to the network may be programmed to be operated by any other node connected to the network.

.2 Network communications shall be capable of supporting "point lists" that can be handled as though they were a single point.

.2 The network shall provide a means to log into any node on the system via a laptop computer or CRT/Keyboard and have complete network access (Set Host) for diagnostics, maintenance reporting, and information gathering of all nodes in the system. Systems not meeting this requirement must provide all diagnostic tools required to support this function from selected points on the network. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.

.3 Work covered by this Section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the Drawings and Specifications.

.4 The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:

.5 Fire alarm and detection operations.
.1 Control and monitoring of smoke control equipment, emergency power systems, and other equipment as indicated in the Drawings and Specifications.
.2 Two-way supervised firefighter's phone operations.
.3 One-way supervised automatic voice alarm operations.

1.5 SYSTEM DESCRIPTION

.1 General: Provide a complete, non-coded, addressable, two stage microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the Drawings and as specified herein.

.2 Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory. System shall be capable of storing dual configuration programs with one active and one in reserve. Panel shall be capable of full system operation during a new configuration download. To accommodate this capability, the download of a new Node program will be transferred to a "secondary" configuration memory bank, while the Node continues to function on the "primary" configuration memory bank.

.3 Any systems not complying with this requirement must provide a documented cost allowance to finance the deployment of a comprehensive fire watch team. The fire watch team will be present before, during and after the Node re-program commences, and until the new changes have been verified in compliance with CAN/ULC-S537

.4 History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.

.5 Recording of Events: Record all alarm, supervisory, and trouble events by means of system printer. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout differentiates alarm signals from all other printed indications.

.6 Wiring/Signal Transmission:

.1 System connections for initiating data communication loops shall be wired DCLA. Signaling line circuits and notification appliance circuits shall be wired DCLA. Provide for 25% minimum spare capacity on all data and signal circuits.

.2 Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone and alphanumeric annunciation.

.7 Remote Access:

.1 FACP shall have the capability to provide remote access via an Internet/Intranet interface. The Internet interface shall provide alternative access to system information using the familiar interface of a standard Internet browser. A remotely located fire professional can use this access to analyze control panel status during non-alarm conditions. In reaction to system events, the Interface will have the ability to broadcast email notification messages to recipients programmed via a standard web-browser interface.

.2 A personal computer or Technician's laptop, configured with terminal emulation software shall have the ability to access the FACP for diagnostics, maintenance reporting and information gathering.

.3 FACP shall have the ability to connect to a third party through a ULC listed gateway for the following protocols: BacNet, Modbus, and CAP.

.4 FACP shall have the capability to provide remote access via an Internet/Intranet Interface. The Internet interface shall provide an alternative access to system information using the familiar interface of a standard Internet browser. A remotely located fire professional can use this access to analyze control panel status during non-alarm conditions and can also use this information to assist local fire responders during alarm conditions. In reaction to system events, the Interface will have the ability to broadcast email notification messages to recipients programmed via a standard web-browser interface.

.8 Network communication:

.1 Network node communication shall be through a true peer-to-peer token ring configuration.

.2 A single open, ground or short on the network communication loop shall not degrade network communications. Token shall be passed in opposite direction to maintain communications throughout all network nodes. At the same time the status of the communication link shall be reported.

.3 If a group of nodes becomes isolated from the rest of the network due to multiple fault conditions, that group shall automatically form a sub-network with all common interaction of monitoring and control remaining intact. The network shall be notified with the exact details of the lost communications.

.4 The network communication method shall be DCLC style (Data Communication Loop CAN/ULC S524 Table 1.).
.5 Communication Loop “DCLC” shall be of two-hour-fire-rated wiring.

.9 Required Functions: The following are required system functions and operating features:
.1 Priority of Signals: Fire alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-, and fourth-level priority respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.
.2 Non-interfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACP after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent addressable device activations.
.3 Transmission to Remote Central Station: Automatically route alarm, supervisory, and trouble signals to a remote central station service transmitter capability.
.4 Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and the remote annunciators, indicating the location and type of device.
.5 Selective Alarm: A system alarm shall include:
.1 Indication of alarm condition at the FACP and the annunciators.
.2 Identification of the device and zone that is the source of the alarm at the FACP and the annunciators.
.3 Operation of audible and visible notification devices on the fire floor, floor above and floor below until silenced at FACP.
.4 Selectively closing doors normally held open by magnetic door holders on the fire floor, floor above and floor below.
.5 Unlocking designated doors.
.6 Shutting down supply and return fans serving zone where alarm is initiated.
.7 Closing smoke dampers on system serving zone where alarm is initiated.
.8 Initiation of smoke control sequence through the building, if any, as per the Drawings and specified herein.
.9 Notifying the local fire department.
.6 Alarm Silencing: If the "Alarm Silence" button is pressed, all audible alarm signals shall cease operation.
.7 System Reset
.1 The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-alarming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."

.2 Should an alarm condition continue, the system will remain in an alarmed state.

.8 A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.

.9 Smoke Detectors:

.1 Monitoring: FACP shall individually monitor detectors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each detector by comparing the detector value to the stored values.

.2 Environmental Compensation: The FACP shall maintain a moving average of the detector's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.

.3 Programmable Sensitivity: Photoelectric Smoke Detectors shall have 9 selectable sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACP.

.4 Sensitivity Testing Reports: The FACP shall provide detector reports that meet CAN/ULC-S537 and CAN/ULC-S536 calibrated test method requirements. The reports shall be viewed on a CRT Display or printed for annual recording and logging of the calibration maintenance schedule.

.5 The FACP shall automatically indicate when an individual detector needs cleaning. The system shall provide a means to automatically indicate when a detector requires cleaning. When a detector's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate if a detector is close to a trouble reporting condition and will be indicated on the FACP as "ALMOST DIRTY." This condition provides a means to alert maintenance staff of a detector approaching dirty without creating a trouble in the system. If this indicator is ignored and the second level is reached, a "DIRTY DETECTOR" condition shall be indicated at the FACP and subsequently a system trouble is reported . The detector base LED shall glow steady giving a visible indication at the detector location. The "DIRTY DETECTOR" condition shall not affect the sensitivity level required to alarm the detector. If a "DIRTY DETECTOR" is left unattended, and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY DETECTOR" trouble condition shall be indicated at the control unit.

.6 The FACP shall continuously perform an automatic self-test on each detector that will check detector electronics and ensure the accuracy of the values being transmitted. Any detector that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.]

.7 Multi-Detectors shall combine photoelectric smoke sensing and heat sensing technologies. An alarm shall be determined by either smoke detection, with selectable sensitivity from 0.2 to 3.7

%/ft obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.

.8 Programmable bases. It shall be possible to program relay and sounder bases to operate independently of their associated detector.

.9 Magnet test activation of smoke detectors shall be distinguished by its label and history log entry as being activated by a magnet.

.10 Audible Alarm Notification: By horns and horn/strobes in areas as indicated on Drawings.

.10 Power Requirements

.1 The control unit shall receive AC power via a dedicated fused disconnect circuit or a circuit breaker.

.2 The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 2 hours of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.

.3 All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control unit.

.4 The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously at the user interface while incoming power is present.

.5 The system batteries shall be supervised so that a low battery or a depleted battery condition, or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.

.6 The system shall support NAC Lockout feature to prevent subsequent activation of Notification Appliance Circuits after a Depleted Battery condition occurs in order to make use of battery reserve for front panel annunciation and control.

.7 The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.

.8 Loss of primary power shall sound a trouble signal at the FACP. FACP shall indicate when the system is operating on an alternate power supply.

1.6 SUBMITTALS

.1 General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

.1 Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this Specification. Alternate or as-equal products submitted under this Contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this Specification.

.2 Wiring diagrams from Manufacturer.

.3 Shop drawings showing system details including location of FACP, all devices, circuiting and details of ladder graphic annunciator.
.4 System Power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate per the prescribed backup time periods and under all voltage conditions per ULC standards.
.5 System operation description including method of operation and supervision of each type of circuit and sequence of operations, based on two stage modified fire alarm system, for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, NAC, relay, Detector, and auxiliary control circuits.
.6 Operating instructions for FACP.
.7 Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type of product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.
.8 Product certification signed by the Manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.
.9 Record of field tests of system.
.10 Voice communication intelligibility calculation confirming that it meets or exceeds the requirement of O.B.C. Section 3.2.4.23(2) and necessary recommendation to achieve this requirement (if any).

.2 Submission to authority having jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the authority, make resubmissions if required to make clarifications or revisions to obtain approval.

1.7 QUALITY ASSURANCE

.1 Installer Qualifications: A factory authorized Installer is to perform the work of this Section.

.2 Each and all items of the Fire Alarm System shall be listed as a product of a single fire alarm system Manufacturer under the appropriate category by Underwriters Laboratories of Canada, Inc. (ULC), and shall bear the "ULC" label.

1.8 ACCEPTABLE MANUFACTURERS

.1 Mircom Flex-Net 4000 series network fire alarm system Catalogue numbers are shown and indicate the quality of the devices required. Equivalent devices of the Manufacturers listed below may be use. Acceptable Manufacturers are:
.1 Mircom FX-4003-12NXTDS Extended System
.2 SimplexGrinnell 4100es
.3 Edwards EST-3
.4 Notifier NFS2-3030
.5 Chubb Edwards
.6 or approved equivalent

.2 Being listed as an acceptable Manufacturer in no way relieves obligation to provide all equipment and features in accordance with these Specifications.

.3 The Manufacturer shall be a nationally recognized company specializing in fire alarm and detection systems. This organization shall employ factory trained and CFAA certified Technicians and shall maintain a service organization within 100 miles of this project location. The Manufacturer and service organization shall have a minimum of 10 years experience in the fire protective signaling systems industry.

2 Products

2.1 FIRE ALARM CONTROL PANEL (FACP)

.1 General: Comply with ULC-S527, "Control Units for Fire Alarm Systems."

.2 The following FACP hardware shall be provided:

.1 Main Network Board:

.1 The control panel shall provide three dry contacts for the reporting of common trouble, common alarm, and common supervisory conditions.

.2 Dry contacts shall provide form C (SPDT) connection and be rated at 1A at 24VDC.

.3 The system shall provide one 24 VDC @ 1.7A special applications output for auxiliary equipment. This auxiliary equipment output shall be power limited and equipped with an auto-resettable over-current protection.

.4 The system shall provide a 24VDC, 400mA output for devices and equipment such as four wires detectors. This output shall be shut down when the reset button shall be activated.

.5 Where additional power is required, power supplies shall be used.

.6 The control panel shall provide four NAC lines capable of 1.7 amperes each at 24VDC or 5 Amperes total.

.7 The control panel shall provide connectors for Class A or Class B connection for each NAC output.

.8 Each control panel shall have a capacity of up to 16 conventional input/output adder modules.

.2 Main Display

.1 The display shall be a 4 line by 20-character backlit LCD display or optional 24 lines by 40-character backlit LCD display.

.2 The following panel status shall be indicated by individual LEDs:

.1 System Power (green LED). Illuminated when main AC power is within specs.

.2 Alarm queue (red LED). Flashes when a new alarm has been received.

.3 Trouble queue (yellow LED). Flashes when a new trouble has been received.

.4 Supervisory queue (yellow LED). Flashes when a new supervisory event has been received.

.5 Monitor queue (yellow LED). Flashes when a new trouble has been received.

.6 Ground Fault (yellow LED). Illuminated when a ground fault has been detected.
.7 CPU Fault (yellow LED). Illuminated when processor is unable to perform its tasks.

.3 The queues LED shall turn to steady ON when all related events have been reviewed by the system user through the queues navigation switches.

.4 The following functions shall be controlled by dedicated switches:
.1 Alarm Silence.
.2 Fire Drill.
.3 Alarm Acknowledge (“automatic Alarm signal cancel”).
.4 Alarm Reset.
.5 Trouble Silence.
.6 Lamp Test.
.7 On screen menu key.
.8 Menu Navigation keys (left , right , up and down screen scroll).
.9 Info key for getting more information on displayed event.
.10 OK key to accept menu items.
.11 Cancel key to exit menu items.
.12 Queue navigation and acknowledge keys (one for each queue).

.3 Programmable Input Switch Display Adder
.1 The input switch adder module shall be used to provide 24 programmable switches for functions such as Zone bypass. Each switch shall be equipped with a yellow LED for indicating a trouble condition and with a dual color LED (red and yellow) to indicate an active condition. Active LED color shall be configurable according to the requested function. It shall have on-site labelling capacity for each switch.

.4 Programmable LED Display Adder
.1 The LED display adder shall be used to provide 48 programmable pairs of LED indicators, one yellow and one red with on-site labelling capability.

.5 Programmable Fan Damper Adder
.1 The Fan Damper display adder shall be used to provide fan damper control. Each adder shall provide 8 switches with three non-momentary positions: OFF - AUTO - MAN control. LEDs should be provided to indicate the state of each fan controlled by a switch and to report eventual trouble condition if the fan system has proving capability. Model FDX-008KI adder shall be used where one key-switch activated zone is required.

.6 SLC Modules
- .1 Additional SLC circuits shall be supported through adder master and daughter board quad loop controller modules. Each master shall have a dedicated central processor unit (CPU) and shall support two fully loaded SLC lines. The daughter shall provide two additional SLC lines.
- .2 A list of acceptable devices is provided in the Section covering initiating devices.
- .3 SLC lines shall be capable of Class B (single ended) or Class A (looped) wiring arrangement without affecting the total number of SLC lines or devices supported by the system.

.7 Control Panel Conventional Adder Modules
- .1 Conventional input devices can be support by the conventional input circuit adder modules mounted inside the control panels. Each module shall provide four Class A detection or eight Class B circuits. Up to 128 conventional Class B circuits can be connected to a control panel.
- .2 Additional NACs circuits can be support by the NAC circuit adder modules mounted inside the control panels. Each module shall provide four outputs with connectors for Class A or Class B wiring of each circuit.
- .3 Programmable dry contact relays can be support by the relay circuit adder modules mounted inside the control panels. Each module shall provide 8 form C (SPDT) contacts rated at 1A at 24VDC and shall be individually programmable.

.8 Main Power Supply
- .1 The control panel main power supply shall be 120VAC 60Hz and shall have over-current protection.
- .2 The quality of the AC power shall be monitored by the control panel. There shall be an automatic transfer of power to the back-up power source when AC voltage falls under a level where panel performance is compromised.

.9 Emergency Power Supply
- .1 General: Components include battery, charger, and an automatic transfer switch.
- .2 Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or supervisory mode for a period of 120 minutes.
- .3 The battery charger shall provide full recharge of the selected batteries as per UL requirements.
- .4 The battery charger shall be monitored for integrity and a trouble shall be indicated if battery charging is no more possible or if the battery is disconnected.

.10 Enclosures
- .1 The enclosures back-boxes and doors must be made of heavy gauge steel. They must be suitable for flush or surface mounting.
- .2 All enclosures doors must be equipped with a key lock. On all enclosures where user access is allowed, a dead-front cover must be used for protection.

.11 NAC Booster Power Supply
- .1 It shall have an AC power input rated for either 120VAC 60Hz or 220VAC 50Hz operation.
- .2 The batteries shall be sized according to system requirements calculated in the installation manual.
- .3 The battery charger shall provide full recharge of the selected batteries as per UL requirements.
- .4 The battery charger shall be monitored for integrity and a trouble shall be indicated if battery charging is no more possible.
- .5 The NAC booster power supply shall provide five power-limited outputs rated at 2.5A @ 24VDC. Outputs shall be selectable to be always used for NAC (active during alarms) or power supply duty (active).
- .6 Outputs configured as NAC shall be configurable for Steady, Temporal Code, California Code and March Time rates.
- .7 The NAC booster power supply shall provide a SLC interface allowing it to be controlled as an addressable intelligent device.
- .8 The outputs configured for NAC duty shall also be controllable by analog ON/OFF inputs if the SLC interface is not used.
- .9 The NAC booster power supply shall have built-in protocols for industry-standard devices such as horns and strobes from Amseco, Gentex, System Sensor and Wheelock.
- .10 Configuration of the NAC booster shall be done through DIP switches only.

.12 Addressable Detectors
- .1 All detectors shall be of the detachable head, twist-lock, and plug-in type. The field connections shall be made on a base equipped with self-wiping contacts for the connection of the detector head. Bases shall be either Detector Base with Flange or Detector Base without Flange.
- .2 Addressable devices shall use Addressable Device Programmer for address selection.
- .3 Each detector head occupies any of at least 240 possible Intelligent Sensor addresses on the signaling line circuit (SLC) loop. It responds to regular polls from the system and reports its type and status.
- .4 Detectors shall have an integral LED for alarm indication.
- .5 Bases with remote alarm indicators, relays or audible alarm indicators options shall be provided where required.
- .6 Detectors should have a built-in test feature.
- .7 Photoelectric smoke detector shall be analog intelligent addressable type and use light scattering principle (light emitting

diode source; light sensing photo diode receiver). They shall be easily cleanable and corrosion resistant.

.8 smoke detector shall be an addressable intelligent photoelectric smoke detector and a 135°F fixed thermal sensor in a single sensing device.

.9 Tri-Mode thermal detectors shall be of analog intelligent addressable type with thermistor sensing circuit for 135° Rate of Rise, 135°. Fixed Temperature or 190°. Fixed Temperature.

.10 DNR/DNRW Photoelectric duct smoke detector housings shall be compatible with (remote test switch compatible) photo-electric detectors and shall work with air velocity rates of 100'/min to 4000'/min. Installation of sampling tube shall require no tools and shall be possible from the front or the back of the detector.

.11 Cat. 4000 series.

.13 Addressable Detectors

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.2 Cat. 200 series.

.14 Addressable Manual Pull Stations

.1 Description: Addressable two stage single or double-action type, red LEXAN, with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.

.2 Provide an auxiliary normally closed dry contact for release of local mag lock where required.

.3 Protective Shield: Where required provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations. When shield is lifted to gain access to the station, a battery powered piercing warning horn shall be activated. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.

.4 Cat. 4000 series.

.15 Smoke Detectors

.1 General: Comply with ULC-S5529, "Smoke Detectors for Fire Alarm Systems." Include the following features:

.1 Factory Nameplate: Serial number and type identification.

.2 Operating Voltage: 24 VDC, nominal.

.3 Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.

.4 Each detector base shall contain an LED that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the detector base LED shall be on steady.

.5 Each detector base shall contain a magnetically actuated test switch to provide for easy alarm testing at the detector location.

.6 Each detector shall be scanned by the Control Unit for its type of identification to prevent inadvertent substitution of another detector type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that detector; 2.5% obscuration for photoelectric detector, 135°F and 15°F rate-of-rise for the heat detector but shall indicate a "Wrong Device" trouble condition.

.7 The detector's electronics shall be immune from false alarms caused by EMI and RFI.

.8 Detectors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP. Detector address shall be located in base to eliminate false addressing when replacing detectors.

.9 Removal of the detector head for cleaning shall not require the setting of addresses.

.2 Type: Smoke detectors shall be of the photoelectric or combination photoelectric / heat type. Where acceptable per manufacturer specifications.

.3 Bases: Relay output, sounder and isolator bases shall be supported alternatives to the standard base.

.4 Cat. 4000 series.

.16 Heat Detectors

.1 Thermal Detector: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135°F fixed-temperature setting except as indicated.

.2 Thermal detector shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.

.3 Detector fixed temperature sensing shall be independent of rate-of-rise sensing and] programmable to operate at 135°F or 155°F. Detector rate-of-rise temperature detection shall be selectable at the FACP for either 15°F or 20°F per minute.

.4 Detector shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32°F to 155°F.

.5 Cat. 4000 series.

.17 Standard Alarm Notification Appliances

.1 Horn: horn shall be listed to ULC-S525. The horn may be ceiling or wall mounted. The horn settings include Temporal, Continuous, 20 BPM and March Time. The horn also has Low and High-volume settings for each pattern and tone. The voltage input can be either regulated DC or full wave rectified (FWR) 24-volt operation with an operating range from 16 to 33 RMS. The horn shall have a minimum sound pressure level of 85 dBA @ 24VDC.

The horn shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings. Mini horns are not acceptable.

.2 Strobe: Strobe shall be listed to ULC-S526. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. V/O appliances shall be provided with different minimum flash intensities of 15cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance. The voltage input can be either regulated DC or full wave rectified (FWR) 24-volt operation with an operating range from 16 to 33 RMS. The strobes can be synchronized using built-in sync on the Booster Power Supply or by using a sync module.

.3 Horn Strobes: Fire alarm horn/strobes shall be listed to ULC-S526. Horn/ strobes may be wall mounted and ceiling mounted. The candela output shall be field selectable with multiple settings from 15cd up to 75cd or 110cd depending on the device. The horn settings include Temporal, Continuous, 20 BPM and March Time. The horn also has Low and High-volume settings for each pattern and tone. The voltage input can be either regulated DC or full wave rectified (FWR) 24-volt operation with an operating range from 16 to 33 RMS. The strobes can be synchronized using built-in sync on the Booster Power Supply or by using a sync module. The horn/ strobe shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings.

.4 Notification Appliance Circuit provides synchronization of strobes at a rate of 1Hz and operates horns with a Temporal Code Pattern operation. The circuit shall provide the capability to silence the audible signals, while the strobes continue to flash, over a single pair of wires. The capability to synchronize multiple notification appliance circuits shall be provided.

.5 Accessories: The Contractor shall furnish all necessary accessories.

.18 Addressable Circuit Interface Modules

.1 Addressable Circuit Interface Modules: Arrange to monitor one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of evacuation indicating appliances and AHU systems.

.2 Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line or a separate two wire pair running from an appropriate power supply as required.

.3 There shall be the following types of modules:

.1 Type 1: Monitor Circuit Interface Module:

.2 For conventional 2-wire smoke detector, heat detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACP.

.3 For conventional 4-wire smoke detector and het detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACP.

.4 Type 2: Line Powered Monitor Circuit Interface Module

.1 This type of module is an individually addressable module that has both its power and its communications supplied by the two wire multiplexing signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACP.

.2 This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.

.5 Type 3: Single Address Multi-Point Interface Modules

.1 This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.

.2 This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.

.3 This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.

.6 Type 4: Line Powered Control Circuit Interface Module

.1 This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.

.7 Type 5: 4-20 mA Analog Monitor Circuit Interface Module

.1 This module shall communicate the status of a compatible 4-20 mA detector to the FACP. The FACP shall annunciate up to three threshold levels, each with custom action message; display and archive actual detector analog levels; and permit detector calibration date recording.

.8 All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

.19 Fault Isolator Modules

.1 Installed on data communications loops to isolate a section affected by a short circuit. When isolation is active, the balance of input devices located on wiring sections not directly affected by the short are to continue function normally.

.2 System to indicate short circuit trouble on the affected loop(s)

.20 End of Line Devices

.1 Steel or plastic construction.

.2 Suitable for single-gang standard electrical box mounting.

2.2 WIRING

.1 Power Wires: solid copper conductors, type RW90, rated 600 volt XLPE insulation in approved metal raceways. Minimum #12 AWG.

.2 Fire Alarm Wires and Cables:

.1 Audible/Visual Signal Circuit Wiring - solid copper conductors, type FAS105, rated 600Volt XLPE insulation in approved metal raceways. Minimum #14 AWG.

.2 Addressable loops and Initiation Circuit Wiring – solid copper conductors, type FAS105, 300V PVC flame retardant jacket, shielded. Canada Wire - Securex. Minimum wire size shall be #18 AWG.

.3 Coordinate and confirm fire alarm system wiring requirements with fire alarm system representative prior to start of work.

3 Execution

3.1 INSTALLATION, GENERAL

.1 Install system components and all associated devices in accordance with applicable building code requirements, ULC Standards and Manufacturer's recommendations.

.2 Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:
- .1 Factory trained and certified personnel.
- .2 Canadian Fire Alarm Association (CFAA) personnel.
- .3 Personnel licensed or certified by provincial or local authority.

.3 Allow for commissioning of fire alarm, life safety and fire protection systems as a whole to ensure the proper operation and inter-relationship between the systems, per O.B.C. Section 3.2.4.6.

3.2 EQUIPMENT INSTALLATION

.1 Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.

.2 Existing Fire Alarm Equipment shall be maintained fully operational until the new equipment has been tested and accepted.

.3 Equipment Removal: After acceptance of the new fire alarm system, disconnect and remove the existing fire alarm equipment and restore damaged surfaces. Package operational fire alarm and detection equipment that has been removed and deliver to the Owner. Remove from the site and legally dispose of the remainder of the existing material.

.4 Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.

3.3 WIRING INSTALLATION

.1 System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the authority having jurisdiction (AHJ) and shall be installed in accordance with the appropriate articles from the current approved edition of the Ontario Electric Code (OEC).

.2 Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.

.3 Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

3.4 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.

.2 Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:
- .1 Factory trained and certified.
- .2 Canadian Fire Alarm Association (CFAA) fire alarm certified.
- .3 Certified by a provincial or local authority.
- .4 Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

.3 Pre-testing: Determine, through pre-testing, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pre-testing. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.

.4 Final Test Notice: Provide a 10 day minimum notice in writing when the system is ready for final acceptance testing.

.5 Minimum System Tests: Test the system according to the procedures outlined in CAN/ULC-S537.

.6 Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

.7 Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log.

.8 Report of voice communication system as described in O.B.C. Section 3.2.4.23(2): provide a written record of inspections, tests and detailed test results.

.9 Final Test, Certificate of Completion, and Certificate of Occupancy:
- .1 Test the system as required by the authority having jurisdiction in order to obtain a certificate of occupancy.

3.5 TRAINING

.1 Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.
- .1 Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 8 hours' training.
- .2 Schedule training with the Owner at least 7 days in advance.

END OF SECTION

1 General

1.1 SUMMARY

.1 Provide provision of all labour, materials, equipment and incidental services necessary to provide excavating, trenching, backfill and compaction.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:
- .1 Coordinate work with utilities Sections for clearances and profiles of trenches for utilities.

1.3 SUBMITTALS FOR INFORMATION

.1 Product Data: For foundation drainage piping and accessories, and for protection sheets.

.2 Material Test Reports: For each on-site and imported soil material proposed for fill and backfill as follows:
- .1 Classification according to ASTM D2487.
- .2 Laboratory compaction curve according to ASTM D1557.

.3 Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by excavating and backfilling operations. Submit before earth moving begins.

.4 Qualifications Data: Installer.

1.4 QUALITY ASSURANCE

.1 Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years continuous documented experience on projects of similar scope and size.

.2 Ontario Provincial Standard Specifications (OPSS):
- .1 OPSS 401 – Construction Specification for Trenching, Backfilling, and Compacting.
- .2 OPSS 1004 – Material Specification for Aggregates – Miscellaneous.
- .3 OPSS 1010 – Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material.

1.5 REGULATORY REQUIREMENTS

.1 Excavation must be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects.

.2 Perform excavation work to in accordance with local authorities having jurisdiction.

.3 Conform to Ministry of Environment and Municipal regulations for removal and disposal of excavated materials off-site. Apply, pay for and obtain permits, pay fees and submit declarations associated with disposal of excavated materials.

1.6 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, with Consultant, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, pavement, survey benchmarks and monuments which may be affected by work.

1.7 STORAGE, DELIVERY, HANDLING AND PROTECTION

.1 Stockpile materials in designated areas. Stockpile topsoil and each type of fill material separately to prevent integration. Stockpile granular materials so as to prevent segregation.

.2 Keep surrounding roads free of soil deposits from material hauling trucks. Load trucks carefully to prevent spillage and wind drift.

.3 To protect neighbourhood from wind-blown sand and dust, sprinkle with water entire excavated area and stockpiled excavated materials when required.

.4 Protect adjacent property from damage which may occur from any cause in the performance of the work of this Section.

.5 Do not interfere with use of adjacent buildings.

.6 Take precautions against movement, settlement or collapse of sidewalks, public services adjoining property and be liable for all damage to same.

.7 Before commencing work verify location of survey monuments in the areas in which the work is to be executed. Should any of the monuments be disturbed due to the work be responsible for the expenditures incurred in restoring the monuments.

.8 Take precautions against movement or settlement of existing building. Provide and place bracing and shoring necessary for the safety and support of the structure and execute the work in a manner to prevent movement, settlement, damage or injury caused thereby or resulting therefrom.

.9 Shoring and Trench Timbering:

.1 In addition to requirements of local authorities, carry out in accordance with requirements of the Occupational Health and Safety Act, and regulations for construction projects, and all other applicable regulations of the Ontario Ministry of Labour. In addition, follow recommendations of the Construction Safety Association brochure, "Shoring and Timbering in Trenches, latest edition", wherever applicable.

.10 Shoring and Bracing:

.1 Erect and maintain necessary shoring and bracing for excavations in a manner that will properly retain banks of excavations and prevent cave-in. Shoring to be erected in a manner that will allow all other work to be carried out while shoring is still in place. Shoring installation shall be entirely clear of footings, foundations, walls or other such work so that it may be removed entirely or in sections when it is no longer required or when directed without causing any damage or injury to structural work that has been completed.

2 Products

2.1 FILL MATERIAL

.1 Type 1: Granular A, to OPSS 1010.

.2 Type 2: Granular B, Type 1, (Engineered Fill), to OPSS 1010.

.3 Type 3: selected native material from excavation, having moisture content within 3% of optimum value, approved by Consultant for use intended, unfrozen, free from roots, rocks larger than 75mm cinders, ashes, sods, refuse, or other deleterious materials.

.4 Type 4: clean, coarse concrete sand to CSA A23.1, free from clay, shale, and organic matter.

.5 Type 5: 20mm, clear crushed stone, to CSA A23.1 (rounded aggregate will not be acceptable).

2.2 ACCESSORIES

.1 Protection Sheets: Filter fabric, water-permeable woven fabric of polypropylene or polyolefin, type acceptable to Consultant.

.1 '270R' by Terrafix Geosynthetics Inc, or approved alternate.

3 Execution

3.1 EXAMINATION

.1 Verify existing conditions before starting work.

.2 Do not commence excavating and backfilling operations until temporary erosion and sedimentation control measures are in place.

.3 Do not commence excavating and backfilling operations until preceding surface or layer is approved by Geotechnical Consultant.

.4 Excavating:

.1 Verify that survey benchmark and intended elevations for the Work are as indicated.

.5 Backfilling:

.1 Verify subdrainage and work to foundation walls has been inspected.

.2 Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.

.3 Verify structural ability of unsupported walls to support imposed loads by the fill.

3.2 PROTECTION

.1 Provide acceptable temporary protection to structures, utilities, sidewalks, pavements, adjacent natural growth, landscaping, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavating and backfilling operations.

.2 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.

.3 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.

.4 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.

3.3 SHORING AND BRACING

.1 Protect excavations to provide safe working conditions, prevent cave-ins and falling loose soil, by shoring, bracing, sheet piling, under pinning or method acceptable Geotechnical Consultant. Design and install protection in accordance with requirements of the Occupational Health and Safety Act and the authority having jurisdiction.

.2 Underpin adjacent buildings, structures, utilities damaged by excavation work.

.3 Remove shoring as backfilling operations progress.

3.4 TEMPORARY EROSION AND SEDIMENTATION CONTROL

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

.2 Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree or plant protection zones.

.3 Inspect, maintain, and repair erosion and sedimentation control measures during construction until permanent vegetation has been established.

.4 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.5 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.

3.6 PREPARATION

.1 Lines and Levels:

.1 Establish property lines, benchmarks, main lines, levels and grid lines for the Project. Establish, provide, maintain and protect survey markers and geodetic monuments.

.2 Provide, verify, maintain and protect lines, layouts and grades required for excavating and backfilling work.

.2 Excavating: Notify utility company to remove and relocate utilities.

.3 Backfilling: Conform to OPSS 401 specifications.

.1 Compact subgrade to density requirements for subsequent backfill materials.

.2 Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.

.3 Scarify and proof roll subgrade surface to a depth of 150mm to identify soft spots and facilitate bonding of subsequent materials; fill and compact to density equal to or greater than requirements for subsequent fill material.

.4 Do not commence backfilling until work on foundation walls, drainage and other utilities have been installed, tested and approved.

3.7 EXCAVATING

.1 Excavate subsoil to accommodate building foundations, slabs-on-grade, paving and other items specified or indicated.

.2 Limit damage to existing grade levels to greatest extent possible.

.3 Excavate to lines, grades, elevations, dimensions required with sufficient space to permit erection of formwork, shoring, and installation of materials, piping and similar items. Contour subgrade to provide drainage from entire excavated area when possible.

.4 Extend footings on grade to an elevation capable of sustaining imposed loads of bearing capacity indicated on the Structural Drawings; to a minimum of 1400mm below final exterior grade, for frost protection, unless otherwise indicated; or unless otherwise to a depth directed by Geotechnical Consultant.

.5 Excavate to bearing depths required without interfering with 45° bearing splay of foundations.

.6 Unless otherwise directed by Geotechnical Consultant, limit permanent cut and fill slopes to a slope ratio of 1 horizontal to 1 vertical. Use flatter slopes for permanent slopes containing organic or silty soils.

.7 Subject to requirements of authorities having jurisdiction, provide the following minimum clear working spaces on each side of formwork, unless otherwise pre-approved by the Consultant.

- .1 150mm for footings under 300mm in height.
- .2 300mm for walls under 900mm in height.
- .3 600mm for walls over 900mm in height.

.8 Trench Excavation: Excavate trenches only as far in advance of pipe laying operations and as safety, traffic and weather conditions permit, and in no case exceeding 30m. Prior to stopping work on last day of work week, backfill trenches completely; protect trenches and excavations that cannot be backfilled with approved fencing or barricades and flashing lights.

.9 Grade top perimeter of excavations to prevent surface water from draining into excavation.

.10 Hand trim excavations free of loose materials and debris.

.11 Remove lumped subsoil, boulders, and rock up to 0.25m^3.

.12 Remove all existing tree roots and stumps.

.13 Do not disturb soil within branch spread of trees or shrubs designated to remain. Excavating through roots by hand. Cut roots using a sharp axe or saw.

.14 Notify Consultant of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

.15 Correct areas over excavated areas with fill material and compaction acceptable to Geotechnical Consultant.

.16 Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity.

.17 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 100% Standard Proctor Maximum Dry Density (SPMDD).

3.8 DISPOSAL OFF SITE

.1 Dispose of existing fill and till not suitable for backfilling and compaction and as required to accommodate final site configuration; building foundations, slabs-on-grade, paving and other items specified or indicated.

3.9 PROOF ROLLING

.1 Proof roll subgrade soils with a heavy roller; allow for 2 passes in perpendicular directions for a total of a minimum of 4 passes.

.2 Geotechnical Consultant will review results; proof roll for the Consultant review.

.3 Soft areas detected/identified by the Geotechnical Consultant will be replaced by approved material compacted to 100% standard Proctor maximum dry density.

3.10 BACKFILLING

.1 Backfilling operations: Conform to OPSS 401 specifications.

.2 Do not proceed with backfill operations until Consultant has inspected and approved installations.

.3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.4 Do not use backfill material which is frozen or contains ice, snow or debris.

.5 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.

.6 Prior to installation of foundations, compact existing subgrade to obtain required bearing capacity. Remove "soft" material and fill footing concrete.

.7 Place backfill material in uniform layers not exceeding 152mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.8 Backfill around services:
.1 Place bedding and surround material as specified in fill and compaction schedule.
.2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
.3 Place layers simultaneously on both sides of installed work to equalize loading.
.4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
.1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure, and approval is obtained from Consultant.

.2 If approved by Consultant, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Consultant.

.5 Place material by hand under, around and over installations until 600mm of cover is provided. Dumping material directly on installations will not be permitted.

3.11 SITE QUALITY CONTROL

.1 Testing of materials and compaction will be carried out by testing laboratory designated by the Consultant.

.2 Frequency of Tests:

.1 Excavated surfaces: when undisturbed excavated surface is being prepared, make a series of 3 tests of surface for each 500m^2 area.

.2 Fill under floor or other slabs on grade: make 3 tests for every 2 lifts of compacted fill for each 500m^2 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.

3.12 PROTECTION OF FINISHED WORK

.1 Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

.2 Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

.1 Scarify or remove and replace soil material to depth as directed by Consultant; reshape and recompact.

3.13 FILL AND COMPACTION SCHEDULE

.1 Exterior side of perimeter foundation walls: Type 2 fill to subgrade level. Compact to 95% SPMDD in accordance with ASTM D698.

.2 Under asphalt and concrete paving: Type 2 fill to underside of base course. Compact to 98% SPMDD in accordance with ASTM D698.

.3 Sub-Base Courses for concrete slabs-on-grade:

.1 Engineered Fill: Type 2 fill to underside of base course for floor slabs. Compact to 100% SPMDD in accordance with ASTM D698. Refer to Structural Drawings for location and depth.

.2 Other sub-base within building area: Type 2 to underside of base course for floor slabs. Compact to 98% SPMDD.

.4 Base Course for concrete slabs-on-grade:

.1 Within building area: 152mm Type 1 fill provided by Section 03 30 00. Compact to 100% SPMDD.

.2 Exterior concrete paving: 152mm Type 1 fill provided by Section 03 30 00. Compact to 98% SPMDD.

.3 Moisture Barrier: provide 200mm type 5 clear crushed stone directly below slab on grade vapor barrier.

.5 Underground services:

.1 Sanitary and storm sewer pipe, water pipe, and conduit protective cover: Cradle half diameter of pipe or conduit using 150mm depth of Type 4 fill. After pipe or conduit is in place, cover with 300mm depth of Type 1 fill.

.2 Cable and cable duct bedding and immediate protective cover: Cover bottom of trench with 150mm of Type 4 fill. After cables and ducts are in place, side fill ducts with sand up to top of ducts. Tamp around ducts with hand tampers and cover with 150mm of same material.

.3 Fill above protective cover: In areas within buildings and where paving and walks occur, fill remainder of trench with Type 2 fill. In other areas, fill to subgrade level using Type 3 fill.

.4 Compaction: Compact bedding and immediate protective cover to 100% SPMDD. In areas within buildings and where paving and walks occur, compact remainder of fill to at least 100% SPMDD. In other areas compact remainder of fill to 95% SPMDD.

.5 Notify Consultant 3 days prior to backfilling of trenches for electrical services.

END OF SECTION

1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00
.2 Conform to relevant Sections of Specification for this and other Divisions.

1.2 WORK INCLUDED

.1 Provide duct runs consisting of parallel ducts encased in reinforced concrete, the number and arrangement of ducts as indicated on the Drawings.

.2 Ducts and concrete encasement for Power Supply Authority service cables shall conform to their standards and requirements.

.3 Place and set all ducts and accessories and supervise to ensure integrity of complete installation.

.4 Provide concrete manholes at locations indicated on Drawings.

.5 Construct manholes in accordance with Drawing details and provide all concrete, reinforcing steel, covers and frames, cable racks, cable saddles and insulators, cable pulling loops, grounding system, drainage and connections to underground duct banks as required.

.6 Where manholes are provided for installation of service cables by the Power Supply Authority construct manholes in accordance with their standards and requirements.

1.3 SHOP DRAWINGS

.1 Submit shop drawings for precast manholes in accordance with Section 26 05 00.

2 Products

2.1 PVC DUCTS

.1 PVC ducts, type EB1, encased in reinforced concrete. PVC to comply with CSA Standard CSA C22.2 No.211.1.

2.2 PVC DUCT FITTINGS

.1 Rigid PVC opaque solvent welded type couplings, bell end fittings, plugs, caps, adaptors, solvent and expansion joints as required to make complete installation.

2.3 PRECAST CONCRETE MANHOLES

.1 Precast concrete manholes and auxiliary sections fabricated in steel forms.

.2 C1 35MPA concrete

.3 Aggregates: to CSA-A23.1.

.4 Cement: to CAN/CSA-A5.

.5 Steel welded wire fabric mesh reinforcing: to [CSA G30.3], [CSA G30.5], [CSA G30.18].

.6 Pulling inserts and bolts for racks integrally cast in concrete.

.7 Neoprene gasket seals between manhole sections: to ASTM D 1056.

2.4 DRAINAGE

.1 Floor drain fittings in each manhole consisting of floor drain, back water valve, trap and pipe connection to drainage system.

2.5 MANHOLE NECKS

.1 Concrete brick and mortar.

2.6 MANHOLE FRAMES AND COVERS

.1 Cast iron manhole frames and covers.

2.7 GROUNDING

.1 Ground rods: copper clad steel, ¾" (19mm) diameter x 10' (3m) long.

.2 Grounding conductor: #4 AWG copper ground conductor.

2.8 CABLE RACKS

.1 Hot dipped galvanized cable racks and supports.

.2 ½" x 4" (12 x 100mm) pre-set inserts for rack mounting.

2.9 CABLE PULLING EQUIPMENT

.1 Pulling iron: galvanized steel rods, size and shape as indicated.

.2 Pull rope: ¼" (6mm) stranded nylon or polypropylene, tensile strength 500lb.

2.10 MARKERS

.1 Concrete type cable markers: 2' x 2' x 4" (600 x 600 x 100mm), with words: "cable", "joint" or "conduit" impressed in top surface, with arrows to indicate change in direction of duct runs.

3 Execution

3.1 INSTALLATION GENERAL

.1 Install underground duct banks and manholes including form work.

.2 Build duct bank and manholes on undisturbed soil or on well compacted granular fill not less than 6" (150mm) thick, compacted to 95% of maximum proctor dry density.

.3 Open trench completely between manholes to be connected before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.

.4 Prior to laying ducts in unstable soil, construct "mud slab" not less than 3" (75mm) thick.

.5 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400 (75mm (3") per 30m (100') for drainage and provide drainage facilities as detailed.

.6 Install base spacers at maximum intervals of 5’ (1.5m) leveled to grades indicated for bottom layer of ducts.

.7 Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than 7.5” (190mm) center to center horizontally and vertically. Stagger joints in adjacent layers at least 6” (150mm) and make joints watertight. Encase duct bank with 3” (75mm) thick concrete cover. Use galvanized steel conduit for sections extending above finished grade level.

.8 Make transpositions, offsets and changes in direction using 5 bend sections, do not exceed a total of 20 with duct offset.

.9 Use bell ends at duct terminations in manholes or buildings.

.10 Use conduit to duct adapters when connecting to conduits.

.11 Terminate duct runs with duct coupling set flush with end of concrete envelope when dead ending duct bank for future extension.

.12 Cut, ream and taper end of ducts in field in accordance with Manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.

.13 Allow concrete to attain 50% of its specified strength before backfilling.

.14 Use anchors, ties and trench jacks as required to secure ducts and prevent moving during placing of concrete. Tie ducts to spacers with twine or other non-metallic material. Remove weights or wood braces before concrete has set and fill voids.

.15 Clean ducts before laying. Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.

.16 Immediately after placing of concrete, pull through each duct a steel mandrel not less than 12” (300mm) long and of a diameter ¼” (6mm) less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Avoid disturbing or damaging ducts where concrete has not set completely. Pull stiff bristle brush through each duct immediately before pulling-in cables.

.17 Install four 10’ (3m) lengths of 50’ (15m) reinforcing rods, one in each corner of duct bank when connecting duct to manholes or buildings. Wire rods to 50’ (15m) dowels at manhole or building and support from duct spacers. Protect existing cables and equipment when breaking into existing manholes. Place concrete down sides of duct bank filling space under and around ducts. Rod concrete with flat bar between vertical rows filling voids.

.18 In each duct install pull rope continuous throughout each duct run with 10’ (3m) spare rope at each end.

3.2 MANHOLES

.1 Minimum clear dimensions of 1524mm x 2134mm x 1925mm (5’ x 7’ x 6’-4”) high or larger as required to accommodate the number of duct entries and cables to be installed.

.2 Install precast manholes.

.3 Place concrete in two lifts with slab and sump in first, walls, roof and neck in second lift. Provide key in walls to slab. Place 4” x ¼” (100 x 6mm) PVC water bar vertically in key. Install ground rod before placing slab and place reinforcing steel inserts for cable rack, pulling irons, drain, duct outlets, duct run dowels before casting walls. Make manhole to duct connection as indicated.

.4 Provide 4½” (115mm) deep window to facilitate cable bends in wall at each duct connection. Terminate ducts in bell-end fitting flush with window face. Provide four 30’ (10m) steel dowels at each duct run connection to anchor duct run.

.5 Alternately connect large duct runs by leaving square opening in wall, later pouring duct run and wall opening in one pour and install 1/8” x 10’ (10mm x 3m) reinforcing rods in duct run at manhole connection.

.6 Build up concrete manhole neck to bring cover flush with finished grade in paved areas and 1½” (40mm) above grade in unpaved areas.

.7 Install manhole frames and covers for each manhole. Set frames in concrete grout onto manhole neck.

.8 Drain floor towards sump with 1 to 48 slope minimum and install drainage fittings as indicated.

.9 Install cable racks, anchor bolts and pulling irons as indicated.

.10 Grout frames of manholes. Cement grout to consist of two parts sand and one part cement and sufficient water to form plastic slurry.

.11 Ensure filling of voids in joint being sealed. Plaster with cement grout, walls, ceiling and neck.

.12 Spray paint an "X" on ceiling of manhole above floor drain or sump pit.

3.3 MARKERS

.1 Mark location of duct runs under hard surfaced areas not terminating in manhole with railway spike driven flush in edge of pavement, directly over run. Place concrete duct marker at ends of such duct runs. Construct markers and install flush with grade.

.2 Mark ducts every 500’ (150m) along straight runs and changes in direction.

.3 Where markers are removed to permit installation of additional duct, reinstall existing markers.

.4 Lay concrete markers flat and centered over duct with top 1” (25mm) above earth surface.

.5 Provide Drawings showing locations of markers.

3.4 INSPECTIONS

.1 Inspection of duct will be carried out by Consultant prior to placing. Placement of concrete and duct cleanout to be done when Consultant present.

END OF SECTION