

SPECIFICATIONS

Project Name

PUBLIC WORKS OPERATION CENTRE

Town of Smith Falls

11 Air Care Dr,
Smith Falls, Ontario,

Issued for Permit and Tender

Project Number

26539

Date

2026-06-29

Discipline	Company Name, Address and Name of Professional	Professional Seal
Architect Prime Consultant	IDEA Inc. 200- 310 Hunt Club Road K1V 1C1 Ottawa On. Architect: Chris Warner-Smith	
Mechanical Engineer	IDEA Inc. 200- 310 Hunt Club Road K1V 1C1 Ottawa On. Engineer: Alex Camirand	
Electrical Engineer	IDEA Inc. 200- 310 Hunt Club Road K1V 1C1 Ottawa On. Engineer: Nicholas Frayn	

END OF SECTION

DIVISION 00 PROCUREMENT AND CONTRACTING REQUIREMENTS

00 00 00	Cover Page.....
00 01 07	Seals.....
00 01 10	Table of Contents

DIVISION 01 GENERAL REQUIREMENTS

01 21 00	Allowances.....
01 25 00	Substitution Procedures
01 29 00	Payment Procedures.....
01 31 19	Project Meetings.....
01 32 16.16	Construction Progress Schedule – Critical Path Method (CPM).....
01 33 00	Submittal Procedures
01 35 29	Health, Safety and Emergency Response Procedures.....
01 35 43	Environmental Procedures
01 41 00	Regulatory Requirements.....
01 43 00	Quality Assurance
01 45 00	Quality Control
01 51 00	Temporary Utilities.....
01 52 00	Construction Facilities
01 56 00	Temporary Barriers and Enclosures.....
01 57 00	Temporary Controls.....
01 61 00	Common Product Requirements
01 71 00	Examination and Preparation
01 73 00	Execution
01 74 00	Cleaning.....
01 74 19	Waste Management and Disposal
01 77 00	Closeout Procedures
01 78 00	Closeout Submittals.....
01 91 13	General Commissioning Requirements.....

DIVISION 02 EXISTING CONDITIONS

02 41 13	Selective Site Demolition.....
02 41 13.13	Paving Removal
02 41 16	Structure Demolition

DIVISION 03 CONCRETE

03 10 00	Concrete Forming and Accessories

DIVISION 04 MASONRY

04 05 00	Common Work Results for Masonry
04 05 13	Masonry Mortaring and Grouting.....
04 05 19	Masonry Anchorage and Reinforcement.....
04 22 00	Concrete Unit Masonry.....

DIVISION 05 METALS

05 50 00	Metal Fabrications
05 51 00	Metal Stairs and Ladders.....

DIVISION 06 WOOD, PLASTICS AND COMPOSITES

06 10 53	Miscellaneous Rough Carpentry
06 40 00	Architectural Woodwork.....

DIVISION 07 THERMAL AND MOISTURE PROTECTION

07 05 43	Cladding Support Systems
07 21 13	Board Insulation.....
07 21 16	Blanket Insulation
07 21 19	Urethane Foam Insulating Sealant.....
07 26 00	Vapour Retarders
07 27 00	Air Barriers and Waterproofing
07 42 13	Metal Wall Panels
07 46 19	Steel Siding.....
07 50 10	Cement Faced Insulated Wall Panels
07 52 00	Modified Bituminous Membrane Roofing
07 62 00	Sheet Metal Flashing and Trim.....
07 72 33	Roof Hatches
07 81 00	Applied Fire Protection
07 84 00	Firestopping
07 92 00	Joint Sealants
07 95 13	Manufactured Expansion Joints

DIVISION 08 OPENINGS

08 11 13	Hollow Metal Doors and Frames
08 11 16	Aluminum Doors and Frames.....
08 14 00	Wood Doors.....
08 31 00	Access Doors and Panels
08 36 13.16	Sectional Metal Doors
08 51 13	Aluminum Windows
08 71 00	Door Hardware
08 80 00	Glazing.....
08 87 00	Decorative Glazing Film
08 90 00	Louvers and Vents.....

DIVISION 09 FINISHES

09 21 16	Gypsum Board Assembly
09 22 16	Non-Structural Metal Stud Framing
09 30 13	Ceramic Tile.....
09 51 00	Acoustic Panel Ceilings
09 65 19	Resilient Tile Flooring
09 67 23	Resinous High-Build Epoxy Flooring
09 68 13	Tile Carpeting
09 91 13	Exterior Painting
09 91 23	Interior Painting

DIVISION 10 SPECIALTIES

10 22 26	Operable Partitions.....
10 28 00	Toilet, Bath and Laundry Accessories.....
10 51 13	Metal Lockers

DIVISION 12 FURNISHINGS

12 24 13	Roller Window Shades

DIVISION 13 SPECIAL CONSTRUCTIONS

13 34 19	Metal Building Systems

DIVISION 21 FIRE SUPPRESSION

21 05 01	Common Work Results for Mechanical
21 05 05	Common Work Results for Fire Suppression Systems
21 07 16	Thermal Insulation for Equipment
21 07 19	Thermal Insulation for Piping.....
21 13 13	Wet Pipe Sprinkler Systems

DIVISION 22 PLUMBING

22 10 10	Plumbing Pumps
22 11 16	Domestic Water Piping - Copper
22 13 16.13	Drainage Waste-Vent Piping – Cast Iron-Copper
22 13 16.16	Drainage Waste-Vent Piping - Plastic
22 30 05	Domestic Water Heaters
22 42 00	Commercial Plumbing Fixtures.....
22 42 01	Plumbing Specialties and Accessories.....

DIVISION 23 HEATING, VENTILATING AND AIR-CONDITIONING

23 01 31	Air Duct Cleaning for HVAC Systems
23 05 01	Use of HVAC Systems During Construction
23 05 05	Installation of Pipework.....
23 05 16	Expansion Fittings and Loops for HVAC Piping.....
23 05 19	Thermometer, Pressure, Gauges – Piping Systems
23 05 23	Valves
23 05 29	Hangers and Supports for HVAC Piping Equipment.....
23 05 53_01	Mechanical Identification
23 05 93	Testing Adjusting-Balancing - HVAC.....
23 05 94	Pressure Testing of Ducted Air Systems.....
23 07 13	Duct Insulation
23 08 01	Performance Verification Mechanical Piping
23 11 23	Facility Natural Gas Piping
23 23 00	Refrigerant Piping
23 31 13_01	Metal Ducts – Low Pressure to 500PA.....
23 33 00	Air Duct Accessories
23 33 14	Dampers
23 33 46	Flexible Ducts
23 34 00	HVAC Fans.....

DIVISION 25 INTEGRATED AUTOMATION

25 05 01	BAS General Requirements

DIVISION 26 ELECTRICAL

26 05 00	Common Work Results Electrical
26 05 20	Wires and Box Connectors (0-1000V).....
26 05 21	Wires and Cables (0-1000V)
26 05 28	Grounding
26 05 29	Hangars and Supports For Electrical Systems.....
26 05 31	Splitters, Junction, Pullboxes and Cabinets
26 05 32	Outlet Boxes, Conduit and Fittings

26 05 34	Conduits, Conduit Fastenings and Conduit Fittings
26 05 43	Installation of Cables in Trenches and Ducts
26 09 43	Lighting Controls.....
26 09 43.01	Lighting Control System Design and Cx.....
26 09 43.02	Lighting Control System - System Design and Cx Schedules
26 12 16.01	Dry Type Transformers up to 600V Primary.....
26 24 16	Breaker Type Panel Boards
26 28 13.01	Fuses - Low Voltage
26 28 16.02	Molded Case Circuit Breakers.....
26 28 20	Class A GFCI's
26 28 23	Disconnect Switches - Fused - Non-Fused
26 29 10	Motor Starters to 600V
26 32 13	Backup Power Generation.....
26 36 23	Automatic Transfer Switches.....
26 43 13	Surge Protection Devices
26 50 00	Lighting
26 52 00	Emergency Lighting
26 53 00	Exit Signs.....
26 56 19	Exterior Pole Mounted Lighting
26 60 00	Powered Equipment Schedule

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 None

1.2 CASH ALLOWANCES

- .1 Include in Contract Price specified cash allowances.
- .2 Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage, Installation and other authorized expenses incurred in performing Work.
- .3 Contract Price, and not cash allowance, includes Contractor's Overhead and profit in connection with such cash allowance.
- .4 Contract Price will be adjusted by written order to provide for excess or deficit to each cash allowance.
- .5 Where costs under a cash allowance exceed amount of allowance, Contractor will be compensated for excess incurred and substantiated plus allowance for overhead and profit as set out in Contract Documents.
- .6 Include progress payments on accounts of work authorized under cash allowances in Consultant's monthly certificate for payment.
- .7 Amount of each allowance, for Work specified in respective specification Sections is as follows:
- .1 **Include allowance of \$50,000 for Designated Substance abatement, removal and disposal**
 - .2 **Include allowance of \$45,000 for the work to be completed by Hydro One for new electrical services connections**
 - .3 **Include allowance of \$40,000 for the work to be completed by The Owners Data Contractor**
 - .4 **Include allowance of \$25,000 for testing and inspection**

END OF SECTION

PART 1 General

1.1 SUBSTITUTIONS DURING THE BIDDING PERIOD

- .1 Generally, specific materials, products and systems are specified in the Contract Documents to provide a standard of acceptance. Except where substitutions are specifically excluded in the individual Sections of the specification, equivalent materials, products or systems by other manufacturers are acceptable as substitutions, provided that the properties and compliancy's of the substitutions meet or exceed the properties and compliancy's of the specified materials, products and systems in all respects and that items exposed to sight are of the same appearance as the specified items.
- .2 Substitutions which do not satisfy the above requirements may be rejected by the Consultant. Materials, products and systems which are so rejected shall be replaced by the specified items at no cost to the Contract.
- .3 In the event that, prior to closing of bids, the Bidder wishes to offer a substitution or a proposal of work, materials or methods as an alternative to those described in the Contract Documents, he shall submit a request in writing no later than the time specified herein.
- .4 The request shall include the following:
 - .1 A description of the proposed substitution.
 - .2 In the case of materials, products or systems, a direct comparison between the properties and compliancy's of the specified materials, products or systems with the properties and compliancy's of the proposed substitution, arranged in tabular form, in the same sequence as specified in the applicable specification section or in the sequence listed in the specified manufacturer's published literature, as appropriate.
 - .3 In the case of materials or products, country of manufacture.
 - .4 Shop drawings, product data, and certified test results attesting to the proposed material or product equivalence.
 - .5 If requested by the Consultant, a list of no less than five projects of comparable size and complexity, where the proposed substitution has been used in a similar application. Such projects shall have been in service for at least five (5) years and, where applicable, shall have been subjected to climatic conditions similar to those experienced at the location of the Project. The list shall include the name and current telephone number of the Architect or Prime Consultant for each project.
- .5 The burden of proof is on the proposer. In the event that the Consultant deems the information provided with the request for approval of a substitution to be inadequate, the request may be rejected.
- .6 A request constitutes a representation that the Bidder:
 - .1 Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
 - .2 Will provide the same warranty for the Substitution as for the specified Product.
 - .3 Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to the Owner. (A later claim by Bidder for an addition to Contract Price because of changes in work necessitated by use of substitutions shall not be considered).
 - .4 Waives claims for additional costs or time extension which may subsequently become apparent.
 - .5 Will reimburse the Owner and the Consultant for the cost of review or redesign services associated with re-approval by authorities.

- .7 Substitutions will not be considered in either of the following circumstances:
 - .1 When they are indicated or implied on shop drawing or product data submittals, without a separate written request having been made.
 - .2 When acceptance will require revision to the Contract Documents.
- .8 Where the terms "or equal", "or equivalent" or terms of similar meaning are used in the specifications, this shall not be construed as acceptance of any alternative material, product or system to those specified. The use of these terms does not relieve the Subcontractor from his responsibility to follow the procedures for approval of substitutions specified herein.
- .9 When a request to substitute a Product is accepted, the Consultant will issue an Addendum to known bidders.

1.2 SUBSTITUTIONS AFTER CONTRACT AWARD

- .1 No substitutions will be permitted after award of the Contract without the prior approval of the Consultant by means of a letter of acceptance of the specific substitution.
- .2 In the event that the Trade Contractor wishes to offer a substitution or a proposal of work, materials or methods as an alternative to those described in the Contract Documents, he shall submit a request in writing.
- .3 The request shall include the following:
 - .1 Reasons for the proposed substitution.
 - .2 A description of the proposed substitution.
 - .3 The amount of any credit offered for the substitution.
 - .4 In the case of materials, products or systems, a direct comparison between the properties and compliancy's of the specified materials, products or systems with the properties and compliancy's of the proposed substitution, arranged in a form acceptable to the Consultant.
 - .5 In the case of materials or products, country of manufacture.
 - .6 Shop drawings, product data, and certified test results attesting to the proposed material or product equivalence.
 - .7 If requested by the Consultant, a list of no less than five projects of comparable size and complexity, where the proposed substitution has been used in a similar application. Such projects shall have been in service for at least five (5) years and, where applicable, shall have been subjected to climatic conditions similar to those experienced at the location of the Project. The list shall include the name and current telephone number of the Architect or Prime Consultant for each project.
- .4 Consultant reserves the right to request such additional information as he/she deem necessary prior to acceptance or rejection of a proposed substitution.
- .5 A request constitutes a representation that the Trade Contractor:
 - .1 Has investigated proposed Product and determined that
 - .1 it meets or exceeds the quality level of the specified Product; or
 - .2 the request describes accurately and completely the specific ways in which it fails to meet the quality level of the specified Product.
 - .2 Will provide the same warranty for the Substitution as for the specified Product.
 - .3 Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to the Owner. (A later claim by Bidder for an addition to Contract Price because of changes in work necessitated by use of substitutions shall not be considered).
 - .4 Waives claims for additional costs or time extension which may subsequently become apparent.

- .5 Will reimburse the Owner and the Consultant for the cost of review or redesign services associated with re-approval by authorities.

- .6 When a request to substitute a Product is accepted, the Construction Manager will issue to the Trade Contractor a formal letter of acceptance.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2020, Stipulated Price Contract.

1.2 APPLICATIONS FOR PROGRESS PAYMENT

- .1 Refer to CCDC 2.
- .2 Make applications for payment on account as monthly as Work progresses.
- .3 Date applications for payment last day of agreed monthly payment period and ensure amount claimed is for value, proportionate to amount of Contract, of Work performed and Products delivered to Place of Work at that date.
- .4 Submit to Consultant, at least 14 days before first application for payment. Schedule of values for parts of Work, aggregating total amount of Contract Price, to facilitate evaluation of applications for payment.

1.3 SCHEDULE OF VALUES

- .1 Refer to CCDC 2.
- .2 Provide schedule of values supported by evidence as Consultant may reasonably direct and when accepted by Consultant, be used as basis for applications for payment.
- .3 Include statement based on schedule of values with each application for payment.
- .4 Support claims for products delivered to Place of Work but not yet incorporated into Work by such evidence as Consultant may reasonably require to establish value and delivery of products.

1.4 PROGRESS PAYMENT

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

1.5 SUBSTANTIAL PERFORMANCE OF WORK

- .1 Refer to CCDC 2.
- .2 Prepare and submit to Consultant comprehensive list of items to be completed or corrected and apply for a review by Consultant to establish Substantial Performance of Work or substantial performance of designated portion of Work when Work is substantially performed if permitted by lien legislation applicable to Place of Work designated portion which Owner agrees to accept separately is substantially performed]. Failure to include items on list does not alter responsibility to complete Contract.
- .3 No later than 10 days after receipt of list and application, Consultant will review Work to verify validity

of application, and no later than 7 days after completing review, will notify Contractor if Work or designated portion of Work is substantially performed.

- .4 Consultant: state date of Substantial Performance of Work or designated portion of Work in certificate.
- .5 Immediately following issuance of certificate of Substantial Performance of Work, in consultation with Consultant, establish reasonable date for finishing Work.

1.6 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF WORK

- .1 Refer to CCDC 2.
- .2 After issuance of certificate of Substantial Performance of Work:
 - .1 Submit application for payment of holdback amount.
 - .2 Submit sworn statement that accounts for labour, subcontracts, products, construction machinery and equipment, and other indebtedness which may have been incurred in Substantial Performance of Work and for which Owner might in be held responsible have been paid in full, except for amounts properly retained as holdback or as identified amount in dispute.
- .3 After receipt of application for payment and sworn statement, Consultant will issue certificate for payment of holdback amount.
- .4 Where holdback amount has not been placed in a separate holdback account, Owner will, 10 days prior to expiry of holdback period stipulated in lien legislation applicable to Place of Work, place holdback amount in bank account in joint names of Owner and Contractor.
- .5 Amount authorized by certificate for payment of holdback amount is due and payable on day following expiration of holdback period stipulated in lien legislation applicable to Place of Work. Where lien legislation does not exist or apply, holdback amount is due and payable in accordance with other legislation, industry practice, or provisions which may be agreed to between parties. Owner may retain out of holdback amount sums required by law to satisfy liens against Work or, if permitted by lien legislation applicable to Place of Work, other third party monetary claims against Contractor which are enforceable against Owner.

1.7 PROGRESSIVE RELEASE OF HOLDBACK

- .1 Refer to CCDC 2.
- .2 Where legislation permits, if Consultant has certified that Work of subcontractor or supplier has been performed prior to Substantial Performance of Work, Owner will pay holdback amount retained for such subcontract Work, or products supplied by such supplier, on day following expiration of holdback period for such Work stipulated in lien legislation applicable to Place of Work.
- .3 In addition to provisions of preceding paragraph, and certificate wording, ensure that such subcontract Work or products is protected pending issuance of final certificate for payment and be responsible for correction of defects or Work not performed regardless of whether or not such was apparent when such certificates were issued.

1.8 FINAL PAYMENT

- .1 Refer to CCDC 2, GC 5.7.
- .2 Submit application for final payment when Work is completed.

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

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 ADMINISTRATIVE

- .1 Schedule and administer project meetings throughout the progress of the work at the call of Consultant.
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting four days in advance of meeting date to Consultant.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .7 Reproduce and distribute copies of minutes within three days after meetings and transmit to meeting participants and, affected parties not in attendance.
- .8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Senior representatives of Consultant, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM).
 - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
 - .5 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
 - .6 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
 - .7 Owner provided products.
 - .8 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .9 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
 - .10 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
 - .11 Monthly progress claims, administrative procedures, photographs, hold backs.
 - .12 Appointment of inspection and testing agencies or firms.
 - .13 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

- .1 During course of Work and weeks prior to project completion, schedule progress meetings bi-monthly.
- .2 Contractor, major Subcontractors involved in Work and Consultant and Owner are to be in attendance.
- .3 Notify parties minimum 5 days prior to meetings.
- .4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within 3 days after meeting.
- .5 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measures and procedures to regain projected schedule.
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed changes for affect on construction schedule and on completion date.
 - .12 Other business.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 DEFINITIONS

- .1 Activity: Distinct, scheduled portion of work performed during course of a project.
- .2 Activity Duration: time in calendar units between start and finish of a scheduled activity. See also Duration.
- .3 Assumption: factor in planning process that is considered true, real, or certain without proof or demonstration.
- .4 Bar Chart (Gantt Chart): graphic display of schedule-related information.
 - .1 In typical bar chart, schedule activities or work breakdown structure components are listed down left side of chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars.
- .5 Baseline: approved version of a work product that can be changed only through formal change control procedures and is used as a basis for comparison.
- .6 Budget: approved estimate for a project or work breakdown structure component or schedule activity.
- .7 Cash Flow: projection of progress payment requests based on cash loaded construction schedule.
- .8 Change Control: process whereby modifications to documents, deliverables, or baselines associated with a project are identified, documented, approved, or rejected.
- .9 Completion Milestones: they are firstly [Interim Certificate] [Substantial Completion] and secondly Final Certificate.
- .10 Constraint: scheduled limiting factor that effects execution of a project, program, portfolio, or process.
- .11 Contract: mutually binding agreement that obligates a seller to provide a specified product or service or result and obligates a buyer to pay for it.
- .12 Control: comparing actual performance with planned performance, analyzing variance, assessing trends, to effect process improvements, evaluating possible alternatives, and recommending appropriate corrective action as needed.
- .13 Corrective Action: intentional activity that realigns performance of project work with project management plan.
- .14 Critical Path: sequence of activities that represents longest path through a project, which determines shortest possible duration.
- .15 Critical Path Activity: activity on critical path in a project schedule.
- .16 Critical Path Method (CPM): method used to estimate minimum project duration and determine amount of scheduling flexibility on logical network of paths within schedule model.
- .17 Data Date: point in time when the status of the project is recorded.

- .18 Decomposition: technique used for dividing and subdividing project scope and project deliverables into smaller, more manageable parts.
 - .19 Deliverable: unique and verifiable product, result, or capability to perform a service that is required to be produced to complete a process, phase, or project.
 - .20 Duration: total number of work periods (not including holidays or other non-working periods) required to complete a schedule activity or work breakdown structure component.
 - .1 Usually expressed as workdays or work weeks.
 - .21 Early Finish Date (EF): in Critical Path Method, earliest possible point in time when uncompleted portions of schedule activity can finish based on schedule network logic, data date, and schedule constraints.
 - .1 Early finish dates can change as Project progresses and changes are made to Project plan.
 - .22 Early Start Date (ES): in Critical Path Method, earliest possible point in time when uncompleted portions of a schedule activity can start based on schedule network logic, data date, and schedule constraints.
 - .1 Early start dates can change as Project progresses and changes are made to Project Plan.
 - .23 Execute: directing, managing, performing, and accomplishing project work; providing deliverables, and providing work performance information.
 - .24 Finish Date: point in time associated with a schedule activity's completion.
 - .1 Usually qualified by one of following: actual, planned, estimated, scheduled, early, late, baseline, target, or current.
 - .25 Float: (also known as slack) amount of time a schedule activity can be delayed without delaying early start date of a successor or violating a schedule constraint.
 - .1 This resource is available to both [PWGSC] and Contractor.
 - .26 Forecast: estimate or prediction of conditions and events in project future based on information and knowledge available at time of forecast.
 - .1 Information is based on projects past performance and expected future performance, and includes information that could impact project in future, a such as estimate at completion and estimate to complete.
 - .27 Gantt Chart: see Bar Chart.
 - .28 Impact Analysis: schedule analysis technique that adds a modeled delay to an accepted construction schedule to determined possible outcome of that delay on project completion.
 - .29 Imposed Date: a fixed date imposed on a schedule activity or schedule milestone, usually in form of a "start no earlier than" and "finish no later than" date.
 - .30 Lag: amount of time whereby a successor activity is required to be delayed with respect to a predecessor activity.
 - .31 Late Finish Date (LF): in critical path method, latest possible point in time when uncompleted portions of a schedule activity can finish based on schedule network logic, project completion date, and schedule constraints.
 - .32 Late Start Date (LS): in critical path method, latest possible point in time when uncompleted portions of a schedule activity can start based on schedule network logic, project completion date, and schedule constraints.
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- .33 Lead: amount of time whereby a successor activity can be advanced with respect to a predecessor activity.
- .34 Logic Diagram: see Project network diagram.
- .35 Logical Relationship: dependency between two activities or between an activity and a milestone.
- .36 Master Schedule: summary-level schedule that identifies major deliverable; work breakdowns structure components, and key schedule milestones.
- .37 Milestone: significant point or event in a project, program, or portfolio.
- .38 Monitor: collect project performance data with respect to a plan, procedure performance measures, and report and disseminate performance.
- .39 Network: see Project Schedule Network Diagram.
- .40 Non-Critical Activities: activities which when delayed, do not affect specified Contract duration.
- .41 Project Control System: fully computerized system utilizing commercially available software packages.
- .42 Project Management: application of knowledge, skills, tools, and techniques, to project activities to meet project requirements.
- .43 Project Management Plan: approved document that describes how project will be executed, monitored, and controlled.
 - .1 Primary uses of Project management plan are to document planning assumptions and decisions, facilitate communication among stakeholders, and document approved scope, cost, and schedule baselines.
 - .2 Project management plan may be summary or detailed.
- .44 Project Management Planning: development and maintenance of Project Management Plan.
- .45 Project Management Planning, Monitoring and Control System: overall system operated to enable monitoring of Project Work in relation to established milestones.
- .46 Project Schedule: planned dates for performing activities and planned dates for meeting milestones.
- .47 Project Schedule Network Diagram: graphical representation of logical relationships among project schedule activities.
 - .1 Always drawn from left to right to reflect Project chronology.
- .48 Project Scope: work performed to deliver a product, service, or result with specified features and functions.
- .49 Quantified days duration: working days based on 5 day work week, discounting statutory holidays.
- .50 Risk: uncertain event or condition that, if it occurs, has positive or negative effect on one or more project objectives.
- .51 Schedule: see Project Schedule.
- .52 Schedule Data: collection of information for describing and controlling schedule.
- .53 Scope: see Project Scope.

- .54 Start Date: point in time associated with activity's start, usually qualified by one of following: actual, planned, estimated, scheduled, early, late, target, baseline, or current.
- .55 Work Breakdown Structure (WBS): hierarchical decomposition of total scope of work to be carried out by project team to accomplish project objectives and create the required deliverables.

1.2 REFERENCE STANDARDS

- .1 Project Management Institute (PMI Standards)
 - .1 A Guide to the Project Management Body of Knowledge (PMBOK Guide) -Fifth Edition.
 - .2 Practice Standard for Scheduling -2011.

1.3 ALLOWANCES

- .1 Include as cash allowance [] to cover provision of project control services in accordance with Section [01 21 00 - Allowances].

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Project Meeting:
 - .1 Meet with Consultant within 10 working days of Award of Contract date, to establish Work requirements and approach to project construction operations.
 - .2 Participate in regular project progress meetings with Consultant specifically intended to discuss update of detailed schedule and contract changes.
- .2 Scheduling:
 - .1 Ensure that planning process is iterative and results in generally top-down processing with more detail being developed as planning progresses, and decisions concerning options and alternatives are made.
 - .2 Ensure project schedule efficiencies through monitoring of project in detail to ensure integrity of Critical Path, by comparing actual completions of individual activities with their scheduled completions, and review progress of activities that has started but are not yet completed.
 - .3 Monitor sufficiently often so that causes of delays can immediately be identified and mitigated.
- .3 Project monitoring and reporting:
 - .1 Keep team aware of changes to schedule, and potential consequences as project progresses.
 - .2 Use narrative reports to provide advice on seriousness of challenges and measures to overcome them.
 - .3 Begin narrative reporting with statement on general status of project followed by summarization of delays, potential problems, corrective measures and project status criticality.
- .4 Critical Path Method (CPM) Requirements:
 - .1 Ensure Master Plan and Detail Schedule are practical and remain within specified contract duration.
 - .2 Revise Master Schedule and Detail Schedule deemed impractical by Consultant and resubmit for approval.
 - .3 Change to Contract Duration:
 - .1 Acceptance of Master Schedule and Detail Schedule showing scheduled Contract duration shorter than specified Contract duration does not constitute change to Contract.
 - .2 Duration of Contract may only be changed through bilateral Agreement.
 - .4 Consider Master Schedule and Detail Schedule deemed practical by Consultant, showing Work completed in less than specified Contract duration, to have float.
 - .5 First Milestone on Master Schedule and Detail Schedule will identify start Milestone with an Early Start, "ES", constraint date equal to Award of Contract date.

- .6 Calculate dates for completion of milestones from Plan and Schedule using specified time periods for Contract.
- .7 Substantial Completion with Late Finish, "LF", constraint equal to calculated date.
- .8 Calculations on updates such that if early finish of Interim Certificate falls later than specified Contract duration then float calculation to reflect negative float.
- .9 Delays to non-critical activities with float may not be basis for time extension.
- .10 Do not use float suppression techniques such as software constraints, preferential sequencing, special lead/lag logic restraints, extended activity times or imposed dates other than required by Contract.
- .11 Allow for adverse weather conditions normally anticipated and show in Master Plan and Detail Schedule.
 - .1 Specified Contract duration has been predicated assuming normal amount of adverse weather conditions.
- .12 Provide necessary crews and manpower to meet schedule requirements for performing Work within specified Contract duration.
 - .1 Simultaneous use of multiple crews on multiple fronts on multiple critical paths may be required.
- .13 Arrange participation on and off site of subcontractors and suppliers, as required by Consultant, for purpose of network planning, scheduling, updating and progress monitoring.
 - .1 Approvals by Consultant of original networks and revisions do not relieve Contractor from duties and responsibilities required by Contract.
- .14 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Consultant Project Control System for planning, scheduling, monitoring and reporting of project progress.
- .3 Include costs for execution, preparation and reproduction of schedule submittals in bid documents.
- .4 Submit letter ensuring that schedule has been prepared in co-ordination with major sub-contractors.
- .5 Refer to article "PROGRESS MONITORING AND REPORTING" of this specification Section for frequency of Project control system submittals.
- .6 Submit impact analysis of schedule for changes that result in extension of contract duration.
 - .1 Include draft schedule update and report as outlined in article "PROGRESS MONITORING AND REPORTING".
- .7 Submit Project planning, monitoring and control system data as part of initial schedule submission and monthly status reporting in following form.
 - .1 Email files in original scheduling software [] containing schedule and cash flow information, labelled with data date, specific update, and person responsible for update.
 - .2 Master Schedule Bar Chart.
 - .3 Construction Detail Schedule Bar Chart.
 - .4 Listing of project activities including milestones and logical connectors, networks (sub-networks) from Project start to end. Sort activities by activity identification number and accompany with descriptions. List early and late start and finish dates together with durations, codes and float.

- .5 Criticality report listing activities and milestones with zero and up to 5 days total float used as first sort for ready identification of critical or near critical paths through entire project. List early and late starts and finishes dates, together with durations, codes and float for critical activities.
- .6 Progress report in early start sequence, listing for each trade, activities due to start, 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.

1.6 QUALITY ASSURANCE

- .1 Use experienced personnel, fully qualified in planning and scheduling to provide services from start of construction to Final Certificate, including Commissioning.

1.7 WORK BREAKDOWN STRUCTURE (WBS)

- .1 Prepare construction Work Breakdown Structure (WBS) within 10 working days of Award of Contract date.
 - .1 Develop WBS through at least five levels: project, stage, element, sub-element and work package.

1.8 PROJECT MILESTONES

- .1 Mandatory and recommended project milestones form targets for both Master Schedule and Detail Schedule of CPM construction network system.
 - .1 [Mandatory] [Recommended]: excavation completed within [] working days of Award of Contract date.
 - .2 [Mandatory] [Recommended]: substructure completed within [] working days of Award of Contract date.
 - .3 [Mandatory] [Recommended]: superstructure completed within [] working days of Award of Contract date.
 - .4 [Mandatory] [Recommended]: building closed-in and weatherproofed within [] working days of Award of Contract date.
 - .5 [Mandatory] [Recommended]: interior finishing and fitting, mechanical and electrical work completed within [] working days of Award of Contract date.
 - .6 [Mandatory] [Recommended]: interim Certificate (substantial completion) within [] working days of Award of Contract date.
 - .7 [Mandatory] [Recommended]: outside work completed within [] working days of Award of Contract date.
 - .8 [Mandatory] [Recommended]: final Certificate completion within [] working days of Award of Contract date.

1.9 MASTER SCHEDULE

- .1 Structure and base CPM construction networks system on WBS coding in order to ensure consistency throughout Project.
- .2 Prepare comprehensive construction Master Schedule (CPM logic diagram) and dependent Cash Flow Projection within 10 working days of finalizing Agreement to confirm validity or alternates of identified milestones.
 - .1 Master Schedule will be used as baseline.
 - .1 Revise baseline as conditions dictate and as required by Consultant.
 - .2 Consultant as Project progresses will review and return revised baseline within 10 work days.

- .3 Reconcile revisions to Master Schedule and Cash Flow Projections with previous baseline to provide continuous audit trail.
- .4 Initial and subsequent Master Schedule will include:
 - .1 Email containing schedule and cash flow information, clearly labelled with data date, specific update, and person responsible for update.
 - .2 Bar chart identifying coding, activity durations, early/late and start/finish dates, total float, completion as percentile, current status and budget amounts.
 - .3 Network diagram showing coding, activity sequencing (logic), total float, early/late dates, current status and durations.
 - .4 Actual/projected monthly cash flow: expressed [annually] [and] [monthly] and shown in both graphical and numerical form.

1.10 DETAIL SCHEDULE

- .1 Provide detailed project schedule (CPM logic diagram) within 10 working days of Award of Contract date showing activity sequencing, interdependencies and duration estimates. Include listed activities as follows:
 - .1 Shop drawings.
 - .2 Samples.
 - .3 Approvals.
 - .4 Procurement.
 - .5 Construction.
 - .6 Installation.
 - .7 Site works.
 - .8 Testing.
 - .9 Commissioning and acceptance.
- .2 Detail CPM schedule to cover in detail minimum period of 12 months beginning from Award of Contract date with duration of each activity.
 - .1 Show remaining activities for CPM construction network system up to Final Certificate and develop complete detail as project progresses.
 - .2 Detail activities completely and comprehensively throughout duration of project.
- .3 Relate Detail Schedule activities to basic activities and milestones developed and approved in Master Schedule.
- .4 Clearly show sequence and interdependence of construction activities and indicate:
 - .1 Start and completion of all items of Work, their major components, and interim milestone completion dates.
 - .2 Activities for procurement, delivery, installation and completion of each major piece of equipment, materials and other supplies, including:
 - .1 Time for submittals, resubmittals and review.
 - .2 Time for fabrication and delivery of manufactured products for Work.
 - .3 Interdependence of procurement and construction activities.
 - .3 Include sufficient detail to assure adequate planning and execution of Work. Activities generally range in duration from [3] to [15] workdays each.
- .5 Provide level of detail for project activities such that sequence and interdependency of Contract tasks are demonstrated and allow co-ordination and control of project activities. Show continuous flow from left to right.

- .6 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 length of Project to form "Critical Path". Increased number of critical activities is seen as indication of increased risk.
- .7 Insert Change Orders in appropriate and logical location of Detail Schedule. After analysis, clearly state and report to Consultant for review effects created by insertion of new Change Order.

1.11 REVIEW OF CONSTRUCTION DETAIL SCHEDULE

- .1 Allow minimum 5 work days for review by Consultant of proposed construction Detail Schedule unless otherwise specified.
- .2 Upon receipt of reviewed Detail Schedule make necessary revisions and resubmit to Consultant for review within maximum 5 work days unless otherwise specified.
- .3 Promptly provide additional information to validate practicability of Detail Schedule as required by Consultant.
- .4 Submittal of Detail Schedule indicates that it meets Contract requirements and will be executed generally in sequence.

1.12 COMPLIANCE WITH DETAIL SCHEDULE

- .1 Comply with reviewed Detail Schedule.
- .2 Proceed with significant changes and deviations from scheduled sequence of activities that cause delay, only after [written] receipt of approval by Consultant.
- .3 Identify activities that are behind schedule and causing delay. Provide measures to regain slippage.
 - .1 Corrective measures may include:
 - .1 Increase of personnel with more experience/qualifications on site for effected activities or work package.
 - .2 Increase in materials and equipment.
 - .3 Overtime work
 - .4 Additional work shifts.
- .4 Submit to Consultant, justification, project schedule data and supporting evidence for approval of extension to Contract completion date or interim milestone date when required. As part of supporting evidence, include:
 - .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 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 Consultant.
 - .4 Do not assume approval of Contract extension prior to receipt of written approval from Consultant.
- .5 In event of Contract extension, display in Detail Schedule that scheduled float time available for work involved has been used in full without jeopardizing earned float.
 - .1 Consultant will determine and advise Contractor number of allowable days for extension of Contract based on project schedule updates for period in question, and other factual information.

- .2 Construction delays affecting project schedule will not constitute justification for extension of contract completion date.

1.13 PROGRESS AND REPORTING

- .1 On an ongoing basis, Detail Schedule on job site to show "Progress to Date". Arrange participation on and off site of subcontractors and suppliers, as, and when necessary, for purpose of network planning, scheduling, updating and progress monitoring. Inspect Work with Consultant at least once monthly to establish progress on each current activity shown on applicable networks.
- .2 Update and reissue project Work Breakdown Structure and relevant coding structures as project develops and changes.
- .3 Perform Detail Schedule update monthly with status dated (Data Date) on last working day of month. Update to reflect activities completed to date, activities in progress, logic and duration changes.
- .4 Do not automatically update actual start and finish dates by using default mechanisms found in project management software.
- .5 Submit to Consultant copies of updated Detail Schedule.
- .6 Requirements for monthly progress monitoring and reporting are basis for progress payment request.
- .7 Submit monthly written report based on Detail Schedule, showing Work to date performed, comparing Work progress to planned, and presenting current forecasts. Report summarize progress, defining problem areas and anticipated delays with respect to Work schedule, and critical paths. Explain alternatives for possible schedule recovery to mitigate potential delay. Include in report:
 - .1 Description of progress made.
 - .2 Pending items and status of: permits, shop drawings, change orders, possible time extensions.
 - .3 Status of Contract completion date and milestones.
 - .4 Current and anticipated problem areas, potential delays and corrective measures.
 - .5 Review of progress and status of Critical Path activities.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Submit to Consultant submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal 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 before 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 considered rejected.
- .6 Notify Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify site measurements and affected adjacent Work are coordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.
- .10 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to Contract drawings and specifications.
- .4 Allow 10 days for Consultant's review of each submission.
- .5 Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant before to proceeding with Work.

- .6 Make changes in shop drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of revisions other than those requested.
 - .7 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data, and sample.
 - .5 Other pertinent data.
 - .8 Submissions to include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of site measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified site dimensions and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
 - .9 After Consultant's review, distribute copies.
 - .10 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request.
 - .11 Submit 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.
 - .12 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Consultant.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of Contract award for project.
 - .13 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Consultant.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of Contract complete with project name.
-

- .14 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Consultant.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Safety Data Sheets concerning impedances, hazards and safety precautions.
- .15 Submit electronic copies of Manufacturer's Site Reports for requirements requested in specification Sections and as requested by Consultant.
- .16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .17 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Consultant's
- .18 Delete information not applicable to project.
- .19 Supplement standard information to provide details applicable to project.
- .20 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.

1.3 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Consultant's [business address.
- .3 Notify Consultant in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 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 before proceeding with Work.
- .6 Make changes in samples which Consultant may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.4 MOCK-UPS

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

1.5 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic copy of colour digital photography in jpg format, fine resolution monthly with progress statement and as directed by Consultant.
 - .2 Project identification: name and number of project and date of exposure indicated.
-

- .3 Number of viewpoints: 4 locations.
 - .1 Viewpoints and their location as determined Consultant.
- .4 Frequency of photographic documentation: weekly.
 - .1 Upon completion of: excavation, foundation, framing and services before concealment, of Work, and as directed by Consultant.

1.6 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit [Workers' Compensation Board status].
- .2 Submit transcription of insurance immediately after award of Contract.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 DEFINITIONS

- .1 Hot works: Work involving open flames or producing heat or sparks, including cutting, welding, soldering, brazing, grinding, adhesive bonding, roofing operations, thermal spraying and thawing pipes, and other similar operations.
- .2 Regulatory authority: Governmental agency or other authority which has jurisdiction over the matters in question.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA Z1002:[12], Occupational health and safety — Hazard identification and elimination and risk assessment and control
- .2 Employment and Social Development Canada (ESDC):
 - .1 [R.S.C., 1985, c. L 2, Canada Labour Code](#)
- .3 Government of Ontario:
 - .1 [R.S.O. 1990, C. 01 Occupational Health and Safety Act](#)
- .4 Health Canada (HC):
 - .1 [R.S.C. 1985, c. H-3, Hazardous Products Act](#)
 - .2 [SOR/2015 17, Hazardous Products Regulations](#)

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 File notice of the project with regulatory authorities prior to beginning work.
- .2 Pre-construction safety meeting: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by the Consultant and Subcontractors to:
 - .1 Verify project health and safety requirements.
 - .2 Review known or foreseeable health or safety hazards.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Site-specific health and safety plan:
 - .1 Include, at minimum:
 - .1 Documentation requirements in accordance with CSA Z1002.
 - .2 On-site contingency and emergency response plans: Address standard operating procedures to be implemented during emergency situations.
 - .2 Submit minimum 10 Working Days before beginning work at the work site.
 - .1 The Consultant may respond if concerns are noted.
 - .2 Resubmit, with noted corrections, of deficiencies or concerns before beginning work at the work site.
- .3 Submit electronic copies of health and safety inspection reports submitted to regulatory authorities.
- .4 Submit electronic copies of reports or directions issued by regulatory authorities.

- .5 Submit electronic copies of incident and accident reports.
- .6 Submit electronic copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDSs) in accordance with WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM in this section.

1.5 REGULATORY REQUIREMENTS

- .1 Comply with Section 01 41 00 - Regulatory Requirements.
 - .1 Comply with the Canada Labour Code and related regulations.
- .2 Comply with the Government of Ontario's Occupational Health and Safety Act and related regulations.

1.6 HEALTH AND SAFETY COORDINATOR

- .1 Appoint a competent and authorized representative as health and safety coordinator to:
 - .1 Conduct health and safety training sessions; prevent people or persons without required training from entering the work site.
 - .2 Develop, enforce, and monitor the site-specific health and safety plan.
 - .3 Be on site during execution of the work.
- .2 Qualifications:
 - .1 Individual with working knowledge of occupational safety and health regulatory requirements and known or foreseeable hazards related to the work.

1.7 SAFETY ASSESSMENT

- .1 Perform site-specific safety hazard assessment in accordance with CSA Z1002.
- .2 Work at site is expected to involve:
 - .1 General construction hazards.
 - .2 Working at heights.
 - .3 Working in enclosed spaces.
 - .4 Contact with asbestos-containing materials.
 - .5 Contact with lead-based paints.
 - .6 Contact with polychlorinated biphenyl (PCB).
 - .7 Contact with mould.
- .3 Develop written site-specific health and safety plan, referencing the project specifications and based on hazard assessment, before beginning work at the work site/

1.8 GENERAL REQUIREMENTS

- .1 Prioritize safety and health of the public and site personnel and protection of environment over cost and schedule considerations for the work.
- .2 Protect health and safety of people or persons on site or adjacent to the site, safety of property on site or adjacent to the site, people or persons adjacent to site and environment to extent that they may be affected by the work.
- .3 Assume the role of the constructor in accordance with the Government of Ontario's Occupational Health and Safety Act and related regulations.
- .4 Provide proper site separation and identification in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

- .5 Post applicable documents, articles, notices, and orders in conspicuous location on site in accordance with regulatory requirements.
- .6 Provide first aid facilities and an accident prevention program in accordance with regulatory requirement.
- .7 Provide appropriate emergency facilities, as specified in SDSs, where workers might be exposed to contact with chemicals, including eye-wash facilities and emergency showers.
 - .1 Train workers in use of emergency equipment.
- .8 Provide appropriate personal protective equipment as specified in SDSs.
 - .1 Properly fit workers for personal protective equipment.
 - .2 Train workers in care, use, and maintenance of personal protective equipment.

1.9 FIRE SAFETY REQUIREMENTS

- .1 Comply with Ontario Fire Code, Section 5.17., Hot Works,
- .2 Ventilate areas of hot work by use of suitable portable supply and exhaust fans.
- .3 Ventilate hot work in enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
- .4 Provide continuous fire watch during hot work and for minimum 1 hour after. Perform final visual inspection after fire watch completion or 4 hours after completion of the work.
 - .1 Use thermal scanners or infrared thermometers to take temperature readings if visual inspection is impeded by obstructions.
- .5 Burning rubbish or construction waste materials: In accordance with Section 01 35 43 - Environmental Procedures.

1.10 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factors, hazards, or conditions occur during the work, follow procedures in place in accordance with employees' rights to refuse work and other regulatory requirements. Advise the health and safety coordinator and Consultant verbally and in writing.

1.11 WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM

- .1 Provide products that comply with Hazardous Products Regulations and other regulatory requirements regarding use, handling, labelling, storage, and disposal of hazardous materials.
- .2 Deliver copies of applicable SDSs to the work site and the Consultant. Provide SDSs in compliance with Hazardous Products Regulations for hazardous products that will be used in the work. Locate SDSs in accessible locations for workers and visitors throughout the site, bound and organized in binders.
- .3 Maintain access to current SDSs on site at all times.
- .4 Deliver hazardous products to site only after delivery of acceptable SDSs.
- .5 Train workers required to use or work in close proximity to hazardous products in accordance with regulatory requirements.
- .6 Label controlled products at work site in accordance with Hazardous Products Regulations and other regulatory requirements.

1.12 BLASTING AND EXPLOSIVES

- .1 Blasting or use of explosives is not permitted.

1.13 OVERLOADING

- .1 Prevent loading any part of the structure during the construction with a load greater than it is calculated to bear safely when complete. Ensure temporary supports are as strong as permanent supports. Prevent placing loads on concrete floors, roofs until they have attained their permanent set.

1.14 POWDER ACTUATED DEVICES

- .1 Obtain written authorization from the Consultant before using powder actuated devices.

1.15 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by regulatory authorities or by the Consultant.
- .2 Submit written reports of actions taken to correct non-compliance.
- .3 The Consultant may stop work if non-compliance is not corrected.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Requirements for:
 - .1 Development and implementation of a site-specific environmental protection plan (EPP);
 - .2 Plant preservation;
 - .3 Burning trash and other waste and fires;
 - .4 Work adjacent to waterways; and
 - .5 Restoring disturbed areas.

1.2 DEFINITIONS

- .1 Environmental protection: Prevention and control of pollution and habitat- or environment-disruption during construction.
- .2 Environmental protection plan (EPP): Comprehensive, site-specific overview of known or potential environmental issues to be addressed on-site during construction.
- .3 Erosion: Deterioration, displacement, or transportation of land surface by wind or water, intensified by land clearing practices related to construction work.
- .4 Sediment: Soil, debris, and other particulate matter, transported by storm or well production run off water, and deposited as a layer of solid particles within a waterbody.
- .5 Urban heat islands (UHIs): Warmer temperatures in urban areas than in surrounding rural areas.

1.3 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA Z809:16, Sustainable Forest Management
- .2 Environment and Climate Change Canada (ECCC):
 - .1 [S.C. 2002, c. 29, Species at Risk Act](#)
- .3 Forest Stewardship Council (FSC):
 - .1 FSC-STD-01-001-v5-3, FSC Principle and Criteria for Forest Stewardship
- .4 Sustainable Forestry Initiative (SFI):
 - .1 SFI 2022, Standards and Rules
- .5 United States Environmental Protection Agency (EPA), Office of Water:
 - .1 EPA-833-R-06-004 - Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Permits:
 - .1 Pay for, and obtain, permits before tree removal in accordance with the authority having jurisdiction (AHJ) requirements and Section 01 41 00 - Regulatory Requirements.
- .2 Coordination:

- .1 Coordinate with Section 01 57 00 - Temporary Controls for provision, monitoring, and maintenance of:
 - .1 Temporary erosion and sediment controls;
 - .2 Temporary pest control;
 - .3 Temporary stormwater pollution control; and
 - .4 Temporary site dust control.
- .2 Coordinate with Section 01 74 19 - Waste Management and Disposal for development of the solid waste disposal plan to align with the construction waste management plan.
- .3 Pre-construction training: Train site personnel on environmental protection requirements at the work site, before their first day on site.
 - .1 Minimum training requirements:
 - .1 Construction Equipment fuelling;
 - .2 Spill prevention and response;
 - .3 Good housekeeping protocols;
 - .4 Material handling; and
 - .5 Waste material handling.
- .4 Scheduling:
 - .1 Schedule vegetation removal and management or removal of hazardous trees or tree limbs within the regional timing window of least risk for breeding birds, and before the instream window, whenever possible.
 - .2 Schedule instream works and vegetation removal, if required, during the regional timing window to avoid disruption of fish and wildlife habitat.
 - .3 Take extra precaution when fish or species at risk are present at the work site.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Site quality control submittals:
 - .1 Detailed digital photographs indicating temporary erosion and sediment controls.
 - .1 Submit every 2 weeks.
 - .2 Inspection and maintenance logs for control measures.
 - .1 Submit every 2 weeks.

1.6 ENVIRONMENTAL PROTECTION PLAN (EPP)

- .1 Submit an EPP, before delivering materials to the work site or [commencing construction work, in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Address topics at level of detail commensurate with environmental issues applicable to the work site and required construction tasks.
- .3 Minimum requirements:
 - .1 Environmental protection personnel: Names and qualifications of people responsible for:
 - .1 ensuring adherence to the EPP;
 - .2 manifesting hazardous waste to be removed from site; and
 - .3 training site personnel.
 - .2 Description of the environmental protection training program, outlining the minimum training requirements specified in ADMINISTRATIVE REQUIREMENTS in this section.
 - .3 Contact information for local environmental emergency response agencies.

- .4 Site work plan: Identify work areas for proposed activities in each portion of area. Identify areas of limited use or non-use.
 - .1 Include measures for marking limits of use areas and methods for protecting features to be preserved within authorized work areas.
- .5 Drawings: Identify locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
- .6 Traffic control plan: Identify measures to reduce erosion of temporary and existing roadbeds by construction traffic, especially during wet conditions.
 - .1 Include measures to minimize amounts of material transported onto paved public roads by vehicles or runoff.
- .7 Stormwater pollution prevention plan (SWPPP): [In accordance with EPA-833-R-06-004].
 - .1 Description of existing site conditions:
 - .1 existing land use of the site, such as wooded areas, grassed areas, pavements, buildings, and other structures;
 - .2 locations of surface waters on, or adjacent to, the work site, such as lakes, ponds, rivers, streams, wetlands, and similar water features;
 - .3 soil types at the work site;
 - .4 water bodies to receive site runoff, including the eventual main body of water that receives stormwater; and
 - .5 drainage areas and potential stormwater contaminants.
 - .2 Stormwater management controls and various best management practices required to reduce erosion, sediment, and pollutants in stormwater discharge.
 - .3 Erosion and sediment control plan (ESCP): Identify the types and locations of erosion and sediment controls to be provided on site. Include:
 - .1 drawings showing locations of erosion and sediment controls;
 - .2 methods for maintaining, cleaning, and repairing erosion and sediment controls; and
 - .3 monitoring and reporting requirements to ensure ESC measures comply with the ESCP and AHJ requirements.
 - .4 Proposed waste water management equipment and materials.
 - .1 Product data: Product literature and data sheets for erosion- and sediment-control materials. Include:
 - .1 product characteristics;
 - .2 performance criteria;
 - .3 physical sizes;
 - .4 WHMIS SDSs;
 - .5 methods to prevent soil loss by stormwater runoff and wind erosion;
 - .6 methods to protect soil stockpiles and berms;
 - .7 methods to prevent loss of sediment into storm sewers or adjacent waterways;
 - .8 methods to prevent site dust and particulate matter pollution; and
 - .9 product limitations.
 - .5 Monitoring plan and how controls will be coordinated with construction activities.
 - .6 Schedule and allowances to amend the plan if required.
 - .7 Sample inspection log.
- .8 Spill control plan: Procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .9 Solid waste disposal plan: Identify methods and locations for non-hazardous solid waste disposal, including clearing debris.
- .10 Air pollution control plan (APCP): Identify provisions to contain dust, debris, materials, and trash within the work site.

- .11 Wastewater management plan: Identify methods and procedures for management or discharge of waste waters directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in line flushing.

- .4 Keep a copy of the reviewed EPP on site.

1.7 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify existing conditions, before starting work at the work site in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Identify sensitive areas within and adjacent to the work site, in accordance with the EPP.
 - .2 Assess on-site but previously unknown conditions observed through site verification and discuss whether extra precautions are required with the Consultant.
 - .3 Conduct a visual inspection to confirm the presence or absence of birds and bird nests.
 - .1 If birds or bird nests are present at the work site, the Owner will engage a qualified avian biologist to identify if they are migratory bird nests.
 - .2 If there is evidence of migratory birds or species at risk (SAR) nesting within the work site, the Owner will contact ECCC and request recommendations regarding migratory birds under SAR management options in accordance with the Species at Risk Act.

1.8 PREPARATION

- .1 Protection of in-place conditions:
 - .1 Install required environmental protections, in accordance with the reviewed EPP, before beginning work at the work site.
 - .2 Seal drains and catch basins in close proximity to the work site in accordance with Section 01 57 00 - Temporary Controls.
 - .1 Seal drains and open joints, before sweeping or washing, to prevent material or sediment-laden wash-water from falling or entering waterbodies.
 - .3 Preserve or transplant designated trees, shrubs and vegetation before making site modifications.
- .2 Temporary tree and plant protection:
 - .1 Protect trees and plants on site and adjacent properties in accordance with the Canadian Landscape Standard.
 - .1 Comply with ECCC recommendations regarding migratory birds and SAR management.
 - .2 Wrap trees and shrubs in burlap [where adjacent to construction work, storage areas, and trucking lanes] [where indicated on [Drawings]].
 - .3 Protect burlap-wrapped trees and shrubs with protective wood framework from grade level to minimum height of 2 m [where adjacent to construction work, storage areas, and trucking lanes. Comply with AHJ requirements.
 - .1 Use wood sourced from independently certified well-managed forests in accordance with CSA Z809, FSC STD 01 001, or SFI Standards and Rules.
 - .4 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.
 - .1 Avoid unnecessary traffic, dumping, and material storage over root zones.
 - .2 Minimize the stripping of topsoil and vegetation.
 - .3 Restrict tree removals to areas indicated or designated by the Consultant.

1.9 ENVIRONMENTAL PROTECTION

- .1 Maintain temporary environmental protection in accordance with reviewed EPP.
- .2 Construction Equipment] emissions control:
 - .1 Control emissions from Construction Equipment and vehicles in accordance with AHJ emission requirements.
 - .2 Use new or well-maintained, clean Construction Equipment, preferably] fitted with fully-functional emission control systems, mufflers, exhaust system baffles, and engine covers.
 - .3 Maintain Construction Equipment continuously free of fluid leaks.
- .3 Dust control:
 - .1 Prevent dust, debris, blasting abrasives, and other extraneous materials from contaminating air beyond the work site.
 - .2 Provide temporary enclosures where required.
 - .3 Cover or wet down dry materials and waste to prevent blowing dust and debris. Provide dust control for temporary roads.
- .4 Spill control:
 - .1 Contain and clean up leaks or spills of hazardous materials, in accordance with the reviewed EPP's spill control plan, before beginning work at the work site.
 - .2 Store fuel and other Construction Equipment materials safely and securely.
 - .3 Keep an emergency spill kit on site in case of fluid leaks or spills.
 - .4 Contain and clean up leaks or spill, that occur during the work, immediately.
 - .1 Contact local environmental emergency response agencies as required by the AHJ.
 - .5 Wash, refuel, and service machinery. Store fuel and other materials for the machinery away from waterways to prevent deleterious substances from entering.
- .5 Noise control:
 - .1 Keep construction noise level below restricted levels at the work site and in accordance with AHJ requirements.
 - .2 Repetitive impact noise on the work site shall not exceed the following dB limitations:

Sound Level in dB	Time Duration of Impact Noise
70	12 minutes in any hour
80	3 minutes in any hour

- .3 Provide Construction Equipment sound-deadening devices, and take noise abatement measures that are necessary to comply with these requirements.
- .6 Minimize use of non-chemical fertilizers, herbicides, and other pesticides.
- .7 Maintain erosion and sediment controls until re-vegetation of disturbed areas is achieved.

1.10 PLANT PRESERVATION

- .1 Restrict topsoil and vegetation removal to areas indicated on Drawings.
- .2 Minimize habitat clearing or degrading to optimize the site's natural biodiversity.

1.11 FIRES

- .1 On-site trash and other waste burning and fires are not permitted.

1.12 POLLUTION CONTROL

- .1 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.
- .2 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.13 RESTORATION

- .1 Re-contour, stabilize, and revegetate disturbed areas. Prioritize revegetation and erosion control to slopes leading directly into waterways.
- .2 Revegetate disturbed areas by planting and seeding as specified.
 - .1 Choose locally grown, native plants, ensuring hardiness and drought resistance, suitable to local conditions and low maintenance.
- .3 When there is insufficient time remaining in the current growing season, stabilize such areas and vegetate the following spring. Cover exposed areas with erosion-control blankets.
- .4 Cover revegetated areas with mulch to prevent erosion and help seeds germinate.

1.14 SITE QUALITY CONTROL

- .1 Inspect temporary environmental protection, in accordance with Section 01 57 00 - Temporary Control, regularly during construction. Make repairs if damage occurs.
- .2 Non-conforming work:
 - .1 The Consultant will notify the Contractor, in writing, of observed non-compliance with AHJ requirements or the reviewed EPP.
 - .2 The Consultant may issue a stop work order until satisfactory corrective action has been taken.
 - .1 No changes to the Contract Time or Contract Amount will be granted for such suspensions.
 - .3 Inform the Consultant of proposed corrective actions.
 - .4 Proceed with corrective actions after receipt of written acceptance of the Consultant.

1.15 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning, and:
 - .1 Provide a temporary vehicle wash-down area in accordance with Section 01 57 00 - Temporary Controls.
 - .2 Final cleaning:
 - .1 Begin cleaning and reclamation activities as soon as possible.
 - .2 Clean and remove debris and sediment from drainage devices. Dispose of the debris and collected sediment and prevent them from entering waterways.
 - .3 Remove seals and filter cloth from drains and catch basins after construction is complete. Dispose of seals and filter cloth at an acceptable landfill site.

- .2 Waste management:
 - .1 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal, and:
 - .1 Prevent sediment, debris, concrete, concrete fines, cement, mortar, other Portland cement or lime-containing materials, wash-water, or contact water to into, or around, waterways, sewers, or drainage systems.
 - .2 Limit cast-in-place concrete materials to inside sealed formwork.
 - .3 Prevent foreign materials including garbage, sand, debris, cleaning solvents, and paint from falling or washing into a waterways, sewers, or drainage systems.
 - .4 Stabilize waste materials removed from the work site to prevent them from entering the waterways, sewers, or drainage systems.
 - .5 Spoil piles: Cover with biodegradable mats or tarps, or plant as specified in RESTORATION in this section.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 This Section references laws, bylaws, ordinances, rules, regulations, codes, orders of Authority Having Jurisdiction (AHJ), and other legally enforceable requirements applicable to the Work and that are or become enforced during performance of the Work.

1.2 DEFINITIONS

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

1.3 REFERENCE STANDARDS AND REFERENCE DOCUMENTS

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

1.4 CODES

- .1 Building Code: Perform Work in accordance with the Ontario Building Code (OBC) 2024 including amendments up to the time of bid closing and other codes of provincial or local application.
- .2 Fire Code: Perform Work in accordance with the Ontario Fire Code of Canada (OFC) 2015 including amendments up to the time of bid closing and other codes of provincial or local application.
- .3 If there is a conflict or discrepancy between codes, the most stringent requirements shall apply.
- .4 Specific design and performance requirements listed in Specifications and indicated on Drawings may exceed minimum requirements established by referenced Codes; these requirements will govern over the minimum requirements listed in the referenced Codes.

PART 2 PRODUCTS

2.1 PERMIT REQUIREMENTS

- .1 Development Permit: Owner has applied for, obtained, and paid for development permit.
- .2 Building Permit:
 - .1 Owner has applied for and will be paying for building permit. Contractor is responsible for obtaining or coordinating other permits required for Work and its various parts.

- .2 Contractor will require that specific Subcontractors obtain and pay for some permits required by authorities having jurisdiction (AHJ), where their work is affected by work requiring permits.
- .3 Contractor shall display building permit and other permits in a conspicuous location at the Place of the Work.
- .3 Occupancy Permits:
 - .1 Contractor shall apply for, obtain, and pay for occupancy permits, including partial occupancy permits where required by AHJ.
 - .2 Contractor shall correct deficiencies in accordance with Consultant's instructions. If a deficiency is not corrected, the Owner reserves the right to make correction and charge Contractor for costs incurred.
 - .3 Contractor shall turn occupancy permits over to Owner.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 DEFINITIONS

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

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM E329-20, [Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection](#)

1.3 SECTION INCLUDES

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

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Contractor is responsible for self-performed testing and inspections and submittal of test reports to Consultant.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit certificates for products, process and system for verification by Consultant.
- .3 Submit formal testing and inspections reports per ASTM E329 as indicated in technical specification Sections to Consultant in accordance with contractual agreement.
- .4 Submit one digital copy of each quality assurance inspection and test report Consultant, except where a technical specification Section indicates otherwise.
- .5 Submit mill test certificates as required in technical specification Sections.

1.6 QUALIFICATIONS

- .1 Manufacturers' Qualifications:
 - .1 Specializes in manufacturing the products specified in the technical Section of the Project's construction specification.
 - .2 Minimum 3 years documented experience with a record of successful performance

- .2 Suppliers' Qualifications:
 - .1 Authorized to distribute manufacturer's products
 - .2 has capacity to supply required products without delaying the Project
- .3 Fabricators' Qualifications:
 - .1 experienced in producing products required for this Project
 - .2 successful record of in-service performance
 - .3 sufficient production capacity to fabricate required products without delaying the Project
- .4 Installer Qualifications:
 - .1 firm or individual experienced in design and installation, application, and erection of materials to the extent required for this Project
 - .2 successful record of in-service performance
- .5 Testing and Inspecting Agency Qualifications:
 - .1 accredited organizations by the Standards Council of Canada for testing and inspection
 - .2 capable of reliably performing testing of building products and inspections of construction activities in accordance with ASTM E329.
- .6 Licensed Professionals Qualifications:
 - .1 individual registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.

1.7 CERTIFICATIONS

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

1.8 COORDINATION

- .1 Coordinate and schedule tests and inspections with accredited testing, inspection agencies as indicated in Contract Documents and in accordance with ASTM E329 requirements.
- .2 Obtain Consultant approval before proceeding with tests and inspections, and additional tests and inspections as may be reasonably requested by Consultant.
- .3 Coordinate testing and inspections schedule with SubContractor, testing agencies, and other affected parties.

1.9 SITE SAMPLES

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

1.10 MOCK-UPS

- .1 Mock-ups can be used as a reference for assessing quality of workmanship and site-applied finishes as requested in the project's Contract Documents.
- .2 Obtain Consultant's acceptance of mock-ups installation before beginning to install those portions of the Work represented by the mock-up.
- .3 Assemble mock-ups at the Place of the Work in locations acceptable to Consultant, or where location is indicated in the technical specification Section.
- .4 Schedule mock-ups ready for Consultant's review and in orderly sequence, to avoid delays in Work.
 - .1 Failure to prepare mock-ups in ample time is not considered sufficient reason to request an extension of Contract Time. Claims for extension of Contract Time by reason of such default will not be considered.
- .5 If requested, Consultant will assist in scheduling dates for construction of mock-ups.
- .6 Construct mock-ups using materials, finishes, colours, and methods proposed for the completed Work. Mock-ups to demonstrate proposed workmanship and range of aesthetic appearance.
- .7 Where a mock-up represents or affects multiple specification Sections, coordinate activities of these Subcontractors to ensure mock-ups are complete.
- .8 Modify or replace mock-ups when unacceptable to Consultant.
- .9 Maintain acceptable mock-ups in an undisturbed condition as a standard for judging the completed Work.
- .10 Mock-ups may remain as part of Work, unless indicated otherwise in a technical specification Section.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

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

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Allow and coordinate access to Work on site, manufacturing off site, and fabrication off site with inspection and testing agencies.
- .2 Retain and pay for inspection and testing that are designated for Contractor's own quality control plan, and when testing and inspection are required by AHJ.
- .3 Give advanced notice to Consultant and to each inspection/testing agency for inspection and testing required by Contract Documents or by AHJ.
- .4 In advance of each test, notify appropriate agency and Consultant in the order that attendance arrangements can be made.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit schedule of testing and inspection activities to Consultant, applicable Subcontractors, testing agencies, and other affected parties. Include the following:
 - .1 List each testing and inspection agency
 - .2 Identify types of tests and inspections for each agency, and cross reference to applicable specification Section number-title in Contract Documents
 - .3 Description of test and inspection
 - .4 Identify applicable reference standard
 - .5 Identify test and inspection method
 - .6 Indicate number of each test and inspection required
- .3 Submit one digital copy of each quality assurance inspection and test report to Consultant, except where a technical specification Section indicates otherwise.
- .4 Submit reports for inspection and testing required by Contract Documents or by AHJ and performed by Contractor-retained inspection and testing agencies within [ten] days after inspection or test is completed, except where a technical specification Section indicates a different time period.
- .5 Submit one digital copy of each quality control inspection and test report to Consultant, except where a technical specification Section indicates otherwise.
- .6 Deliver copies of quality control reports to Subcontractor of work being inspected or tested.

1.4 SITE QUALITY CONTROL PROCEDURES

- .1 Provide labour, Construction Equipment, and temporary facilities to obtain and handle test samples and materials on site. Arrange for sufficient space to store and cure test samples.
- .2 Deliver samples and materials required for testing, as requested in technical specification Sections. Submit with reasonable promptness and in an orderly sequence to avoid delays in Work.

1.5 TESTING AND INSPECTION SERVICES

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

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

1.2 TEMPORARY ELECTRICITY

- .1 Provide and pay for temporary electricity for lighting and operating of power tools during construction to a maximum supply of 230 volts 30 amps.
- .2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance, and removal.
- .3 Temporary electricity for electric cranes and other equipment requiring a supply in excess of above is responsibility of Contractor and based on General Conditions of Contract.

1.3 TEMPORARY FIRE PROTECTION

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction and governing codes, regulations and bylaws.

1.4 TEMPORARY HEATING COOLING AND VENTILATING

- .1 Provide temporary heating as required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be of the flameless (vent free) type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and Products against dampness and cold.
 - .3 Prevent moisture and condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation, and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain minimum temperatures of 10°C in areas where construction is in progress.
- .5 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours, or gases in occupied areas during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in a manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Ventilate temporary sanitary facilities.
 - .6 Continue operating ventilation and exhaust system after cessation of work process until complete removal of harmful contaminants is ensured.
- .6 Permanent heating, ventilating, and air conditioning system of building, may be used when available. Be responsible for damage to systems if use is permitted.

- .7 On completion of Work for which permanent heating system is used, replace filters.
- .8 Ensure Date of Substantial Performance and Warranties for heating system does not start until entire system is in as near original condition as possible and is certified by Consultant.
- .9 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .10 Be responsible for damage to Work due to failure to provide adequate heat and protection during construction.

1.5 TEMPORARY LIGHTING

- .1 Provide and maintain temporary lighting throughout Project. Ensure level of illumination on all floors and stairs is not less than [162] lx.
- .2 Electrical lighting systems installed under this Contract may be used for construction requirements only with prior approval of Consultant if warranties are not affected.
 - .1 Repair damage to lighting systems caused by use under this Contract.
 - .2 Replace lamps that have been used for more than 3 months.

1.6 TEMPORARY TELECOMMUNICATIONS

- .1 Provide and pay for temporary telephone, data hook up and lines equipment necessary for own use and use of Consultant.

1.7 TEMPORARY WATER

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

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 INSTALLATION AND REMOVAL

- .1 Provide temporary utilities to execute Work expeditiously.
- .2 Remove all such temporary utilities from site after use.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2020, Stipulated Price Contract.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
 - .2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
- .3 CSA Group (CSA)
 - .1 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-0121-M1978(R2003), Douglas Fir Plywood.
 - .3 CAN/CSA-S269.2-M1987(R2003), Access Scaffolding for Construction Purposes.
 - .4 CAN/CSA-Z321-96(R2001), Signs and Symbols for the Occupational Environment.
- .4 United States Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

1.4 SCAFFOLDING

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding, ramps, ladders, platforms and temporary stairs.

1.5 HOISTING

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

1.6 SITE STORAGE/LOADING

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

1.7 CONSTRUCTION PARKING

- .1 Parking will be permitted on site provided it does not disrupt performance of Work.
- .2 Provide and maintain adequate access to project site.
- .3 Clean runways and taxi areas where used by Contractor's equipment.

1.8 SECURITY

- .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

1.9 OFFICES

- .1 Provide office heated to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide marked and fully stocked first-aid case in a readily available location.
- .3 Subcontractors to provide their own offices as necessary. Direct location of these offices.

1.10 EQUIPMENT, TOOL AND MATERIALS STORAGE

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

1.11 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.
- .3 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures, inside building. Permanent facilities may be used on approval of Consultant.

1.12 CONSTRUCTION SIGNAGE

- .1 Provide and erect project sign, within three weeks of signing Contract, in a location designated by Consultant.

- .2 Construction sign 2m x 2m, of wood frame and plywood construction painted with exhibit lettering produced by a professional sign painter.
- .3 Indicate on sign, name of Owner, Consultant and Contractor, of design style established by Consultant.
- .4 No other signs or advertisements, other than warning signs, are permitted on site.

1.13 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Consultant.
- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .7 Construct access and haul roads necessary.
- .8 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.
- .9 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .10 Dust control: adequate to ensure safe operation at all times.
- .11 Location, grade, width, and alignment of construction and hauling roads: subject to approval by Consultant.
- .12 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- .13 Provide snow removal during period of Work.
- .14 Remove, upon completion of work, haul roads designated by Consultant.

1.14 CLEAN-UP

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

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 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 and sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 California Air Resources Board (CARB):
 - .1 2007 [Suggested Control Measure \(SCM\) for Architectural Coatings](#)
- .2 Canadian Society of Landscape Architects / Canadian Nursery Landscape Association (CSLA/CNLA):
 - .1 Canadian Landscape Standard (CLS), Second Edition
- .3 Environment and Climate Change Canada (ECCC):
 - .1 [S.C. 1999, c. 33, Canadian Environmental Protection Act, 1999](#)
- .4 Forest Stewardship Council (FSC):
 - .1 FSC-STD-01-001-v5-3, FSC Principles and Criteria for Forest Stewardship
- .5 Green Seal (GS):
 - .1 GS-11-21, Paints, Coatings, Stains, and Sealers
- .6 Master Painters Institute (MPI):
 - .1 [Approved Products List \(APL\), online edition](#)
 - .2 [Architectural Painting Specification Manual \(ASM\), online edition](#)
- .7 PEFC Canada:
 - .1 PEFC CAN ST 1001:2025, Sustainable Forest Management
- .8 Sustainable Forestry Initiative (SFI):
 - .1 SFI 2022, Standards and Rules
- .9 South Coast Air Quality Management District (SCAQMD):
 - .1 SCAQMD Rule 1113-2016, Architectural Coatings

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Special procedure submittals:
 - .1 Submit copies of submittals for temporary barriers and enclosures required by the authority having jurisdiction (AHJ) before installation.
 - .1 Temporary barriers and enclosures requiring design by a qualified professional:
 - .1 Signed and sealed by a qualified professional in accordance with Section 01 43 00 – Quality Assurance.

1.3 GENERAL REQUIREMENTS

- .1 Erect temporary barriers and enclosures to protect the public, spaces, adjacent properties, and to secure the work site in accordance with the codes specified in Section 01 41 00 - Regulatory Requirements.
 - .1 Provide signage as required by local regulatory requirements.
 - .2 Sustainability characteristics:
 - .1 Wood products: Sourced from independently certified well-managed forests in accordance with FSC STD 01 001, PEFC CAN ST 1001, or SFI Standards and Rules.

- .2 Maintain temporary barriers and enclosures in good condition, and relocate when required, until affected work is complete.
- .3 Remove temporary barriers and enclosures from site after use.
- .4 Notwithstanding the Contractor's responsibilities for the design, erection, operation, maintenance and removal of temporary work in the General Conditions, this section includes some prescriptive requirements

1.4 TEMPORARY AIR BARRIERS

- .1 Temporary weathertight enclosures:
 - .1 Erect insulated enclosures to unfinished door and window openings, tops of shafts, and at other openings through floors, walls, and roofs.
 - .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heating.
 - .3 Design enclosures to withstand wind pressure and snow loads.

1.5 TEMPORARY DUST BARRIERS

- .1 Erect temporary dust-tight screens, partitions, or enclosures to isolate dust generating activities.
- .2 Seal at floors, ceilings, and walls.
- .3 Protect means of egress with dust-tight zippers, magnetic closure doors, or similar means to keep dust isolated.

1.6 TEMPORARY NOISE BARRIERS

- .1 Provide temporary acoustical barriers or enclosures to reduce sound transmission from noise generating work.

1.7 TEMPORARY FENCING

- .1 Erect temporary perimeter fencing to fully enclose the work site.
- .2 Modular metal panel fencing:
 - .1 Erect temporary site enclosures using minimum 1.8 m high self-supporting corrosion-resistant steel wire mesh fencing, maximum mesh size 50 × 100 mm, with corrosion-resistant steel framing, feet blocks, and bracing as required for stable installation

1.8 TEMPORARY PROTECTIVE WALKWAYS

- .1 Erect protective walkways as required.

1.9 TEMPORARY TREE AND PLANT PROTECTION

- .1 Erect and maintain protective barriers around critical protection zones of trees and plants to remain in accordance with the Canadian Landscape Standard.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 NOT USED

.1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Work in this Section includes requirements for temporary site controls during construction activities, including:
 - .1 temporary soil erosion and sediment control,
 - .2 temporary pest control,
 - .3 temporary environmental control,
 - .4 temporary stormwater pollution control,
 - .5 temporary site dust control,
 - .6 temporary security, and
 - .7 monitoring of temporary controls.

1.2 ABBREVIATIONS

- .1 ESCP: Erosion and Sedimentation Control Plan
- .2 SWPCP: Stormwater Pollution Control Plan

1.3 REFERENCE STANDARDS

- .1 Department of Justice Canada (Jus):
 - .1 Canadian Environmental Protection Act (CEPA), [1999]
- .2 Green Building Initiative (GBI):
 - .1 Green Globes for New Construction 2019 Technical Reference Manual
- .3 United States Environmental Protection Agency (EPA):
 - .1 Construction General Permit (CGP), 2017
 - .2 National Pollutant Discharge Elimination System (NPDES), Stormwater Discharges from Construction Activities, 2017

1.4 TEMPORARY EROSION AND SEDIMENT CONTROL

- .1 Create and implement a site-specific erosion and sedimentation control plan (ESCP) in accordance with EPA, Construction General Permit and NPDES, Stormwater Discharges from Construction Activities as the basis of the plan. Include additional municipal requirements where they are more stringent than Construction General Permit and NPDES, Stormwater Discharges from Construction Activities. ESCP shall:
 - .1 Identify area of disturbance
 - .2 Summarize design requirements that include amount, frequency, intensity, and duration of precipitation
 - .3 Identify stormwater runoff and run-on at the site, including expected flow and controls to minimize peak and total stormwater volume
 - .4 Provide information on soils present on the site
 - .5 Describe stormwater discharge areas to maximize infiltration and increase sediment removal
 - .6 Summarize installation of stormwater controls for each phase of earth disturbance. Include good engineering practice and adherence to manufacturer's recommendations.
 - .7 Include plans for erosion and sediment control maintenance during construction, including inspection and repair schedules.
- .2 Create and implement a training program to educate persons on site about ESCP protocols.

- .3 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil bearing water runoff or prevent airborne dust to adjacent properties, roadways and walkways in accordance with requirements of authority having jurisdiction (AHJ) and as indicated in the Sedimentation Control Plan.
- .4 Temporary Vehicle Wash-Down Area:
 - .1 Prevent mud and soil from accumulating on public roadways.
 - .2 Establish a wash down area for vehicles to remove mud and soil before crossing walkways or entering roadways.
 - .3 Equip wash down area with sedimentation control devices and temporary water supply.
 - .4 Establish a filtering system to prevent harmful fluids (antifreeze, diesel fuel, gasoline) from being flushed into surface drainage system.
- .5 Temporary Sedimentation Control Basins, Silt Fences, and Erosion Control Blankets:
 - .1 Establish one of the following:
 - .1 A sedimentation pond of sufficient size.
 - .2 Geotextile filtering system to control sedimentation from entering surface drainage.
 - .3 Street drainage and sewerage systems.
 - .2 Regularly remove silt accumulations. Dispose off-site at a recognized waste facility.
 - .3 Reapply erosion control polymer as it biodegrades or when worn away.
 - .4 Firmly embed silt fence posts in ground. Secure erosion control fabric to posts.
 - .5 Weigh and peg erosion control blankets so that blankets are in full contact with ground.
- .6 Temporary Stabilized Construction Entrance:
 - .1 Establish a clean gravel pad at each construction entrance of sufficient length and depth to trap clay and excavation debris.
 - .2 Clean gravel on a regular basis to prevent build-up of clay and prevent sediment from being tracked onto roadways.

1.5 TEMPORARY PEST CONTROL

- .1 Perform pest control to minimize attraction and harboring of rodents, insects, and other pests. Perform extermination and control procedures at regular intervals.
- .2 Project shall be free of pests and their residues at Substantial Performance of the Work.
- .3 Perform pest control in accordance with integrated pest management principles with no hazardous or toxic substances released into stormwater or environment.

1.6 TEMPORARY ENVIRONMENTAL CONTROLS

- .1 Use construction methods that comply with environmental regulations and minimize possible air, waterway, and subsoil contamination and pollution.
- .2 Meetings: Train persons on equipment fuelling, spill prevention and response, good housekeeping protocols, material handling, and waste material handling before their first day on site.
- .3 Management:
 - .1 Monitor and repair leaks of polluting liquids on vehicles. Prevent leaks of antifreeze, brake fluid, diesel fuel, gasoline, oil, transmission fluid, and other liquids that may be harmful to the environment or storm drainage systems.
 - .2 Store petroleum products in clearly labelled sealed containers. Provide spill kits and impermeable tarps at fuelling and maintenance areas.
 - .3 Supply a collection skid or similar material for waste materials.

- .4 Tightly seal and store paint containers, sealers, and curing compounds in a protected location when not required. Prevent excess materials from discharging into storm drainage system.
- .5 Prevent concrete trucks from discharging surplus concrete or drum wash water on site.
- .6 Place absorbent materials to soak up excess form release agents. Replace absorbent materials when saturated
- .7 When applying fertilizer, minimize the discharge of pollutants into stormwater.

1.7 TEMPORARY STORMWATER POLLUTION CONTROL

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

1.8 TEMPORARY SITE DUST CONTROL

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

1.9 TEMPORARY SECURITY

- .1 Temporary Site Security:
 - .1 Site Fencing: Before beginning excavation and before construction activities begin, provide temporary site enclosure fencing with lockable gates to prevent unauthorized access.
 - .2 Extent of Fencing: To enclose entire Project site or a portion sufficient to accommodate construction activities.
 - .3 Distribute gate keys to authorized personnel only. Supply Consultant with one set of keys.
- .2 Temporary Building Security:
 - .1 Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized access, vandalism, theft, and similar security violations.
 - .2 Distribute building entrance keys to authorized personnel only. Supply Consultant with one set of keys.

1.10 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit information in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Before starting work of this Section, submit the following:
 - .1 Stormwater Pollution Control Plan (SWPCP): Submit SWPCP indicating methods, plans, and details of controls including:
 - .1 SWPCP coordinator information and their responsibilities
 - .2 Stormwater pollution prevention team to assist in implementation of SWPCP during construction

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

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

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

2.2 TEMPORARY MATERIALS

- .1 Erosion and Dust Control Polymer: Polymer-based, biodegradable, non-dissipating, non-leaching, non-tracking soil stabilizer and dust control agent that binds soil particles. Specifically manufactured for maximum bonding to clay soil particles to decrease erosion potential of exposed earth excavations.
- .2 Steep Slope Erosion Control: Biodegradable geotextile erosion control blanket suitable for medium to steep slope applications designed for long term (greater than 1 year; less than 2 years installation. Use biodegradable anchors and weights to prevent wind displacement and to maintain contact with soil.
- .3 Sediment Traps: Geotextile filter fabric, straw bales, or other similar filtration materials, or silt fence assembly held in place and bound to wood stakes.

- .4 Storm Drain Inlet Protection: Permeable plastic berm designed specifically for erosion and sediment control with erosion control blanket to reduce water velocity and trap sediment.

PART 3 EXECUTION

3.1 CLOSEOUT ACTIVITIES

- .1 Remove temporary control measures shortly before Substantial Performance of the Work or when acceptable to Consultant.
- .2 Restore landscape areas that were damaged by temporary control measures.

3.2 MAINTENANCE

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

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2020, Stipulated Price Contract.

1.2 QUALITY

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

1.3 AVAILABILITY

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

1.4 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Consultant.
- .9 Touch-up damaged factory finished surfaces Consultant's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.5 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation cost of products supplied by Owner will be paid for by Consultant. Unload, handle and store such products.

1.6 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Consultant in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant will establish course of action.
- .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 increase in Contract Price or Contract Time.

1.7 QUALITY OF WORK

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

1.8 CO-ORDINATION

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

1.9 CONCEALMENT

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation inform Consultant if there is interference. Install as directed by Consultant.

1.10 REMEDIAL WORK

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

1.11 LOCATION OF FIXTURES

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Consultant of conflicting installation. Install as directed.

1.12 FASTENINGS

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

1.13 FASTENINGS - EQUIPMENT

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

1.14 PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Consultant.

1.15 EXISTING UTILITIES

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

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

1.2 CLOSEOUT SUBMITTALS

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

1.3 QUALIFICATION ASSURANCE

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

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Existing Services:
 - .1 Confirm locations and extent of service lines in work area before beginning work on site. Submit findings.

- .2 Immediately notify the Consultant if unknown services are encountered. Confirm findings in writing.
- .3 Record locations of maintained, re-routed, and abandoned service lines after completion of the Work. Submit findings.
- .2 Verify substrate and other conditions are acceptable for installation of materials, assemblies, and systems in accordance with required tolerances and manufacturer's instructions and recommendations.
 - .1 Examine conditions, with installers, for defects affecting performance of the Work. Where work of one Section depends on work of other Sections being properly completed, verify that work is complete and suitable to receive the subsequent work.
 - .2 Verify substrate surfaces are clean, dimensionally-stable, cured, and free of contaminants.
 - .3 Proceed with installation after unacceptable conditions are remedied.
 - .4 Starting to cut, patch, or install work will be considered Contractor's acceptance of existing conditions.
 - .5 Monitor conditions as Work proceeds, including items subject to damage or movement during cutting and patching.
- .3 Perform manufacturer-recommended pre-installation site tests.

3.2 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Protect Work and items to remain from damage.
 - .2 Do not load, or permit to be loaded, anything with a weight or force that may endanger the safety or integrity of the Work or items to remain.
 - .3 Support structural integrity of surroundings.
 - .4 Protect exposed work from weather and other potentially damaging conditions. Keep excavations free of water in accordance with Section 01 35 43 – Environmental Procedures.
 - .5 Promptly remove, replace, clean, or repair elements damaged due to inadequate protection, as acceptable to Consultant, and at no change to the Contract Price or Contract Time.
- .2 Surface Preparation:
 - .1 Clean surfaces thoroughly before installation.
 - .2 Prepare surfaces using manufacturer-recommended methods to achieve acceptable substrates under project conditions.

3.3 SURVEY REQUIREMENTS

- .1 Land Survey Reference Points:
 - .1 Existing base horizontal and vertical reference points are indicated on land survey. [Refer to available information in Division 00.
 - .2 Locate and confirm permanent reference points before starting site work. Protect permanent reference points during construction.
 - .3 Notify the Consultant, in writing, if a reference point requires relocation due to changes in grades or locations.
 - .1 Obtain written acceptance of proposed relocations from Consultant.
 - .2 Register new reference points with AHJ.
 - .4 Notify the Consultant, in writing, if a reference point is lost or destroyed.
 - .1 Replace reference points in accordance with original land survey.
- .2 Establish sufficient permanent benchmarks on site by referring back to established benchmarks based on survey reference points.

- .3 Establish initial lines and levels for layout of the Work.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 QUALIFICATIONS

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

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Patching Materials: If possible, use the same materials found in the existing conditions, except in fire-resistance rated materials and assemblies.

- .2 Materials Visible from the Floor Area: Use materials that visually match existing adjacent surfaces, and match existing functional performance.

PART 3 EXECUTION

3.1 COMMON INSTALLATION/APPLICATION/ERECTION REQUIREMENTS

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

3.2 BRACING AND ANCHORING

- .1 Anchors and Fasteners: Unless otherwise indicated elsewhere:
 - .1 Provide any necessary anchors and fasteners to fasten each component securely for its intended purpose. Allow for building movement, including from thermal expansion and contraction of materials and assemblies;
 - .2 prevent electrolytic reaction between dissimilar metals and materials;
 - .3 Provide hot-dip galvanized steel anchors and fasteners for securing exterior work;
 - .4 locate anchors and fasteners within individual load limit or shear capacity. Ensure anchors and fasteners are permanently secured;
 - .5 Where exposed to view, evenly distribute anchors and fasteners in a single area; and
 - .6 Where exposed to view, provide metal anchors, fasteners, and related accessories with the same texture, colour, and finish as adjacent materials.
- .2 Non-Conforming Work: Anchors and fasteners installed which cause substrate cracks or spalling is not acceptable.

3.3 CUTTING AND PATCHING

- .1 Proceed with cutting and patching after the review and acceptance by the Consultant of all submittals listed in Article 1.03, Actions and Informational Submittals.
- .2 Perform cutting, fitting, and patching [including excavation and fill,] to complete Work in accordance with related technical specification Sections.
- .3 Use special techniques to avoid damaging existing conditions that will remain, and which will result in proper surfaces to receive patching and finishing.
- .4 Employ original installer to perform cutting and patching for weather-exposed elements, moisture-resistant elements, and surfaces exposed to view.
- .5 Cut rigid materials using masonry saw, core drill, or other tool recommended by the product manufacturer or applicable industry association. Pneumatic or impact tools are not allowed on masonry work without the approval of Consultant.
- .6 Fit Work [airtight] to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .7 Refinish surfaces to match adjacent finishes. Refinish continuous surfaces to nearest intersection (e.g., edges of partition). Refinish assemblies by refinishing entire unit. Provide entire surface with uniform finish, colour, and texture.

3.4 ADJUSTING

- .1 Remove and replace patching that is visually unsatisfactory to Consultant.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 23 01 05 - Operation and Maintenance of HVAC Systems During Construction
- .2 Section 23 01 31 - Air Duct Cleaning for HVAC Systems
- .3 Section 23 05 00 – Common Work Results for HVAC
- .4 Section 23 08 16 - Cleaning and Start-up of HVAC Piping Systems

1.2 REFERENCE STANDARDS

- .1 CSA Group/International Organization for Standardization (CSA ISO):
 - .1 CSA ISO 14024:[20], Environmental labels and declarations – Type 1 – environmental labelling – Principles and procedures
- .2 United States Environmental Protection Agency (EPA):
 - .1 EPA's Safer Choice Standard, 2009
- .3 Green Seal, Inc. (GS):
 - .1 GS-34-2017, Green Seal Standard for Cleaning and Degreasing Agents
 - .2 GS-37-2022, Green Seal Standard for Cleaning Products for Industrial and Institutional Use
 - .3 GS-40-2020, Green Seal Standard for Floor-Care Products for Industrial and Institutional Use
 - .4 GS-52-2022, Green Seal Standard for Specialty Cleaning Products for Household Use
 - .5 GS-53-2022, Green Seal Standard for Specialty Cleaning Products for Industrial and Institutional Use
- .4 Underwriters' Laboratories Inc. (UL):
 - .1 UL 2759-2011, Standard for Sustainability for Hard Surface Cleaners
 - .2 UL 2767-2011, Standard for Paint and Varnish Remover
 - .3 UL 2777-2011, Standard for Sustainability for Hard Floor Care Products
 - .4 UL 2791-2012, Standard for Sustainability for Drain and/or Grease Trap Additives
 - .5 UL 2792-2012, Standard for Sustainability for Cleaning and Degreasing Compounds: Biologically-based
 - .6 UL 2795-2012, Standard for Sustainability for Carpet and Upholstery Care Products
 - .7 UL 2796-2012, Standard for Sustainability for Odor Control Products
 - .8 UL 2798-2012, Standard for Sustainability for Biological Digestion Additives for Cleaning and Odour Control

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with Section 23 01 05 - Operation and Maintenance of HVAC Systems During Construction, Section 23 01 31 - Air Duct Cleaning for HVAC Systems, [Section 23 05 00 – Common Work Results for HVAC and Section 23 08 16 - Cleaning and Start-up of HVAC Piping Systems for related cleaning requirements.
 - .2 Notify the Consultant if cleaning is required due to actions of the Owner or other contractors.
- .2 Scheduling: Schedule cleaning operations so resulting dust and other contaminants will not fall on recently painted surfaces or contaminate building ventilation systems.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Product literature and data sheets for cleaning products, including product characteristics, performance criteria, WHMIS SDSs, intended uses (surfaces to be cleaned with each product), and limitations.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Provide adequate temporary ventilation during use of volatile or noxious cleaning substances.

3.2 GENERAL REQUIREMENTS

- .1 Use cleaning products recommended by, or acceptable to, the manufacturer of surfaces to be cleaned. Use cleaning products that will not void installed products' warranties.
- .2 Use cleaning products in accordance with manufacturer's instructions.
- .3 Test each cleaning product and procedure in a small inconspicuous area to verify no adverse reaction occurs with surface before proceeding with cleaning remainder of surface.
- .4 Clean stained surfaces as soon as possible.

3.3 PROGRESS CLEANING

- .1 Maintain the Work in a tidy and safe condition, free from accumulation of waste materials and debris, including when caused by the Owner or other contractors.
- .2 Remove dust, debris, and other contaminants from wall and other cavities before enclosing.
- .3 Clean interior areas before start of finish work. Maintain areas free of dust and other contaminants during finishing operations.
- .4 Clean dirt or mud tracked onto paved or surfaced roadways.
- .5 Clear snow and ice from access to buildings, sidewalks and paving, in accordance with local regulations. Remove cleared snow from site.

3.4 FINAL CLEANING

- .1 Remove surplus products, tools, construction machinery, and equipment not required for performance of remaining Work before Consultant's final review.
- .2 Replace broken, scratched, or otherwise disfigured glass and mirrors.

- .3 Clean and polish exposed glass-, mirror-, stainless steel-, and chrome-surfaces.
- .4 Clean hardware, wall tile, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures.
- .5 Remove stains, spots, marks, and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .6 Remove dust and vacuum interior building surfaces, behind grilles, louvres, and screens.
- .7 Wax, seal, or otherwise apply treatments to floor finishes as recommended by each flooring manufacturer.
- .8 Remove paint from:
 - .1 mechanical nameplates;
 - .2 electrical nameplates; and
 - .3 permanent labels required by authorities having jurisdiction or regulatory agencies, such as CSA, cUL, NFPA, ULC, WHI, etc.
- .9 Clean plumbing fixtures to a sanitary condition.
- .10 Clean permanent filters and replace disposable filters for plumbing and HVAC equipment used during construction.
- .11 Remove dust and other contaminants from lighting reflectors, lenses, lamps, bulbs, and other lighting surfaces.
- .12 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .13 Clean and sweep roofs, gutters, downspouts and related drainage systems.
- .14 Remove dirt and other disfiguration from exterior building surfaces.
- .15 Re-clean areas soiled by workers before Owner occupancy.
- .16 Broom clean and power wash exterior sidewalks and stairs.
- .17 Sweep and power wash clean paved areas, including parking areas and roads.
- .18 Clean landscaped areas of construction-related waste and leaves.
- .19 Remove snow and ice from primary pedestrian and vehicular access routes to building.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 The Owner intends for this project to generate the least amount of waste possible and to reduce construction and demolition waste disposed of in landfills and incineration facilities by recovering, reusing, and recycling materials.
- .2 Section includes:
 - .1 Requirements for the development and implementation of a construction and demolition waste management plan (CDWMP).
 - .2 Requirements for management and disposal of construction and demolition waste.

1.2 DEFINITIONS

- .1 Alternative daily cover: Material, other than soils, installed in landfills to cover and seal each day's trash.
- .2 Construction and demolition waste: Solid and liquid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, renovation, repair, or demolition operations.
- .3 Construction and demolition waste management plan: A project-specific plan for the collection, transportation, and disposal of the waste generated at the work site; the purpose of the plan is to ultimately reduce the amount of material being landfilled.
- .4 Hazardous: Exhibiting the characteristics of hazardous substances including properties such as ignitability, corrosiveness, toxicity, or reactivity.
- .5 Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- .6 Recycle: To remove a waste material from the work site to another site for remanufacture into a new product for reuse by others.
- .7 Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .8 Return: To give back reusable items or unused products to vendors for credit.
- .9 Reuse: To reuse a construction waste material in some manner on the work site.
- .10 Salvage: To remove a waste material from the work site to another site for resale or reuse by others.
- .11 Toxic: Poisonous to humans either immediately or after a long period of exposure.
- .12 Trash: Any product or material unable to be reused, returned, recycled, or salvaged. A type of waste.
- .13 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

- .14 Waste management coordinator: The on-site representative responsible for supervising waste management activities, instructing workers, and documenting results of the construction and demolition waste management plan.

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM E3073-17, Standard Guide for Development of Waste Management Plan for Construction, Deconstruction, or Demolition Projects
- .2 International Organization for Standardization (ISO):
 - .1 ISO 14000 family, Environmental management, current versions
- .3 International Organization for Standardization / International Electrotechnical Commission (ISO/IEC):
 - .1 ISO/IEC 17065:2012, Conformity assessment — Requirements for bodies certifying products, processes and services

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Appoint a waste management coordinator (WMC) to supervise waste management activities, instruct workers, and document results of the construction and demolition waste management plan (CDWMP).
- .2 Make arrangements with and obtain permits from authorities having jurisdiction (AHJs) for disposal of waste.
- .3 Pre-construction meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by the Consultant, the Owner, the WMC, and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Develop mutual understanding of the requirements for a consistent policy towards waste reduction and recycling.
- .4 Construction and demolition waste management plan (CDWMP):
 - .1 Prepare a draft CDWMP to provide guidance on a logical progression of tasks and procedures to be followed in a pollution prevention program to reduce or eliminate the generation of waste, the loss of natural resources, and process emissions through source reduction, reuse, recycling, and reclamation.
 - .2 Minimum requirements:
 - .1 Carefully deconstruct and source separate materials/equipment and divert, from D&C waste destined for landfill to maximum extent possible. Target for this project is 75% diversion from landfill. Reuse, recycle, compost, anaerobic digest or sell material for reuse except where indicated otherwise. On site sales are not permitted.
 - .2 Material streams: Analysis of the proposed project waste being generated, including material types and quantities forming a part of identified material streams.
 - .1 Materials removed from site destined for alternative daily cover (ADC) at landfill sites and land clearing debris cannot be considered as contributing to waste diversion and will be included as a component of the total waste generated for the site.
 - .3 Recycling haulers and markets: Identify local haulers and markets for recyclable materials.
 - .4 Waste-to-energy systems: Identify local waste-to-energy incentives where systems for diverting materials from landfill for reuse or recycling are not available.
 - .5 Alternative waste disposal: List each material proposed to be salvaged, reused, recycled, or composted during the project, and the proposed local market for each material.

- .6 Landfill materials: Identify materials that cannot be salvaged, reused, recycled, or composted and include explanation or justification. Waste-to-energy systems may be considered as a viable alternative diversion strategy for these materials where facilities exist [and are operated in accordance with [LEED] [sustainability] program construction and demolition waste management requirements].
- .7 Landfill options: Identify landfills where trash will be disposed. Landfill materials will form a part of the total waste generated by the project.
- .8 Materials handling procedures: Describe how recycled waste materials will be protected from contamination. Describe how recycled waste materials meet with requirements for acceptance by designated facilities.
- .9 Transportation: Describe transportation of the recyclable materials, whether materials will be site separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site. Identify material destinations.
- .10 Other requirements as specified in this section.
- .3 The following sources may be useful in developing the CDWMP:
 - .1 ASTM E3073.
 - .2 LEED Reference Guide for Building Design and Construction.
 - .3 USGBC Construction and Demolition Waste Calculator.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 CDWMP: Submit draft CDWMP as specified in ADMINISTRATIVE REQUIREMENTS in this section.
 - .1 Submit after the pre-construction meeting specified in ADMINISTRATIVE REQUIREMENTS in this section, and before starting work at the work site.
 - .2 Make changes as the Consultant may require, consistent with the Contract Documents. Notify Consultant in writing, when resubmitting, of revisions other than those requested.
 - .3 Distribute copies of the reviewed CDWMP to the Owner, the Consultant, and other parties as required to maintain CDWMP.
- .3 Site quality control submittals:
 - .1 Progress documentation indicating requirements specified in SITE QUALITY CONTROL in this section.
 - .1 Submit with applications for progress payments.
 - .2 Construction and demolition waste management final report as specified in SITE QUALITY CONTROL in this section.
 - .1 Submit within 5 Working Days of Substantial Completion.

1.6 QUALITY ASSURANCE

- .1 Provide on-site instruction to site personnel:
 - .1 Describe appropriate separation, handling, and recycling, salvage, reuse, composting and return methods in accordance with the reviewed CDWMP.
- .2 Qualifications:
 - .1 Recycling facilities:
 - .1 Capable of processing and recycling mixed construction and demolition waste.
 - .2 Certified by a qualified third-party organization that certifies facility average recycling rates include these minimum program requirements:
 - .1 The certification organization follows guidelines for environmental claims and third-party oversight, including ISO/IEC 17065 and relevant portions of the ISO 14000 family of standards.

- .2 The certification organization is an independent third party that continuously monitors certified facilities to ensure they are operating legally and meeting the minimum program requirements for facility certification and recycling rates.
- .3 Certification organizations certify to protocols developed on a consensus basis for recycling facility diversion rates that are not in draft or pilot programs.
- .4 Facility recycling rate calculation methodology:
 - .1 developed with construction and demolition recycling industry stakeholders and specific to the construction and demolition recycling industry;
 - .2 includes methodology applicable across broad regions (such as nationally); and
 - .3 published and publicly available standard.
- .5 Data submitted by the facilities to the certification organization in support of the recycling rate is audited. The audit includes, at a minimum, the evaluation of recyclable sales records, verification of facility sales into commodity markets, an assessment of downstream materials and how these materials are managed after they leave the site, monitoring off-site movement of materials, and a review of the facilities' customers weight tags information.
- .6 Facilities submit data to the certification organization that supports the recycling rate, such as a mass balance recycling rate (metric tonnes in / metric tonnes out) for a 12-month period, or quarterly sorts completed and verified by an independent third-party entity.
- .7 Breakdown of materials (by type and by weight), including analysis of supporting data relating to amounts (in metric tonnes) and types of materials received and processed at the facility.
- .8 At a minimum, the third-party certifying organization conducts an on-site visit of the facility for the first-year certification, with subsequent site visits occurring at least once every two years, unless additional visits are deemed necessary by the certification organization. The certifying organization will:
 - .1 examine how materials enter, are measured, deposited, processed/sorted and exit facility;
 - .2 conduct interviews with key personnel, and discuss how materials are managed after they leave the site;
 - .3 confirm equipment types and capacity;
 - .4 observe and verify load/materials sorting and accuracy; and
 - .5 verify use and accuracy of scales including calibration frequency.
- .9 Diversion rate requirements:
 - .1 Measurements based on weight (not volume), using scales.
 - .2 Diversion rates available on a website and viewable by the general public.
 - .3 Diversion and recycling rate calculation methodologies publicly available and applicable to national-level accounting standards for construction and demolition waste recycling facilities.
- .10 Facility recycling data submitted to certification program will be analyzed for recycling rates using a mass balance formula or quarterly sorts completed and verified by an independent third-party entity.
- .11 Final recycling rate will include overall facility diversion rates with and without ADC / beneficial reuse, and will include separate recycling rates by material type as well as combined average including wood derived fuel / bio-fuel separate from other waste to energy or incineration end-markets.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Separation facilities: Lay out and identify a specific area to facilitate separation of materials for potential recycling, salvage, reuse, composting, and return.
- .2 Provide on-site dump containers for collection of waste.
- .3 Locate separation facilities and on-site containers minimum 3.0 m away from buildings.

3.2 WASTE MANAGEMENT REQUIREMENTS

- .1 Implement the reviewed CDWMP to collect and separate waste materials appropriate to available recycling and reuse programs in the project area.
- .2 Keep recycling bins, waste bins, and separation facilities neat, clean, and clearly labeled to avoid cross-contamination of materials.
- .3 Prevent waste destined for landfill from mixing with recycled materials.
- .4 Clean contaminated materials before placing in collection containers.
- .5 Product containers:
 - .1 Seal empty product containers and store safely.
 - .2 Collect, package, and temporarily store partly used or unused product containers for recycling.
- .6 Store oily waste in approved receptacles to maximize cleanliness and safety.
- .7 Deposit greasy or oily rags and materials subject to spontaneous combustion in purpose-built receptacles. Remove at end of each work day.
- .8 Handle and dispose of hazardous materials in accordance with AHJ requirements.
- .9 Place materials defined as hazardous or toxic in designated containers.
 - .1 Storing flammable and combustible waste liquids on site is prohibited. Remove daily or more frequently as directed by the Consultant.
 - .2 Store volatile waste in covered metal containers.
 - .3 Manage unused sealants as hazardous materials.

3.3 REMOVAL AND DISPOSAL REQUIREMENTS

- .1 Remove waste including that caused by the Owner or other contractors.
- .2 Remove waste from the work site at regularly scheduled times.
- .3 Remove volatile waste from site at end of each work day.
- .4 Burning waste materials on site is prohibited.
- .5 Dispose of waste off site.
 - .1 Arrange for collection by, or delivery to, appropriate recycling or reuse facilities.
 - .1 Recycle metal materials at metal recycling facilities.
 - .2 Materials designated for recycling or reuse: Transport materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling process.

- .3 Obtain written authorization from the Consultant before deviating from haulers, waste diversion facilities, landfills, or receiving organizations listed in the CDWMP.

3.4 SITE QUALITY CONTROL

- .1 Progress documentation:
 - .1 Prepare monthly progress reports indicating cumulative totals representing progress towards achieving diversion and reduction goals of waste materials away from landfills and identifying any special programs, landfill options, or alternatives to landfills used during construction. Include:
 - .1 amounts, in tonnes or m³, and locations of material landfilled;
 - .2 amounts, in tonnes or m³, and locations of materials diverted from landfill; and
 - .3 progress based on total waste generated by the project with materials diverted from landfill as a percentage.
 - .4 Copies of transportation documents or shipping manifests indicating weights of materials, and other evidence of disposal indicating final locations of waste diverted from landfill and waste sent to landfill.
- .2 Construction and demolition waste management (CDWM) final report:
 - .1 Prepare a final report containing detailed information indicating total waste produced by the project, types of waste material and quantity of each material, and total waste diverted and diversion rates indicated as a percentage of the total waste produced.
 - .1 Compile all information into a single CDWM final report when multiple waste hauling and diversion strategies were used for the project.
 - .2 Detail major waste streams generated, including disposal and diversion rates:
 - .1 Accounting: Information indicating total waste produced by the project.
 - .2 Composition: Information indicating types of waste material and quantity of each material.
 - .3 Diversion rates: Information indicating total waste diverted from landfill as a percentage of the total waste produced by the project.
 - .4 Transportation documentation: Copies of transportation documents or shipping manifests indicating weights of materials, and other evidence of disposal indicating final locations of waste diverted from landfill and waste sent to landfill.
 - .5 ADC: Submit quantities of material that were used as ADC at landfill sites, and that form a part of the total waste generated by the project.
 - .6 Photographs: Photographs of waste diversion facilities, documenting location and signage describing usage of waste separation containers, and in accordance with Section 01 33 00 - Submittal Requirements.

3.5 SAMPLE CONSTRUCTION WASTE MANAGEMENT FORMS

- .1 This sample waste tracking form is an example of the information required for recording management of construction waste:

	Material Stream	Diverted Waste by Report Date				Total	Units
		Sept			Oct	Nov	Dec
Material Streams Contributing to Credit	Plastic	1.25	2.5	10	5	18.75	m ³
	Carpet	2.5	2.5	2.5	0	7.5	m ³
	Paper/Cardboard	5	2.5	2.5	5	15	m ³
	Clean Wood	0	25	0	1.25	26.25	m ³
	Metal	1.25	2.5	5.5	7	16.25	m ³
	Gypsum Board	2.5	2.5	4	5	14	m ³
	Brick/Concrete	10.5	2.5	5.5	8.75	27.25	m ³
	Asphalt Shingles	10	0	0	0	10	m ³
	Total Diverted Waste	33	40	30	32	135	m ³
Material Streams not Contributing to Credit	Landfill	10.75	7.5	15	10	43.25	m ³
	Screen Fines (ADC)	5	1.25	0	2.5	8.75	m ³
	150 mm Minus (ADC)	1.25	1.25	5	5.5	13	m ³
	Total Landfill/ADC Waste	17	10	20	18	65	m ³
	Total Waste	50	50	50	50	200	m ³
	Percent Diverted	66	80	60	64	67.5	%

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 Environment and Climate Change Canada (ECCC):
 - .1 [SOR/2008-197, Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations](#)
- .2 ULC Standards (ULC):
 - .1 CAN/ULC-S1001-11, Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Acceptance of Work Procedures:
 - .1 Contractor's inspection: Conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Consultant in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
 - .2 Request Consultant's review.
 - .2 Consultant's review:
 - .1 Consultant and Contractor to review Work and identify deficiencies and defects.
 - .2 Contractor to correct Work as directed.
 - .3 Completion tasks: Submit written certificates in English that tasks have been performed as follows:
 - .1 Work: Completed and inspected for compliance with Contract Documents.
 - .2 Defects: Corrected.
 - .3 Deficiencies: Completed.
 - .4 Equipment and systems: Tested, adjusted and balanced and fully operational.
 - .5 Certificates required by Utility companies: Submitted.
 - .6 Verification letter required to confirm integrated systems testing for fire protection and life safety systems has been successfully completed in accordance with CAN/ULC-S1001.
 - .7 Operation of systems: Demonstrated to Owner's personnel.
 - .8 Commissioning of mechanical systems: Completed in accordance with Section 01 91 13 – General Commissioning Requirements and final commissioning report submitted to the Consultant.
 - .9 Work: Complete and ready for final review.
 - .4 Final review:
 - .1 When completion tasks are done, request final review of Work by the Consultant, and Contractor.
 - .2 When Work is incomplete according to the Owner, Consultant, and authorized agencies, complete outstanding items and request an additional review.
 - .5 Declaration of Substantial Performance: When the Consultant considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
 - .6 Commencement of lien and warranty periods: The date of Owner's acceptance of submitted declaration of [Substantial Performance] will be the date for commencement of warranty period and commencement of lien period, unless otherwise required by the lien statute at the Place of the Work.

- .7 Final payment:
 - .1 When the Consultant considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.
 - .2 When the Work is deemed incomplete by the Consultant, complete outstanding items and request an additional review.
- .8 Payment of holdback: After issuance of Certificate of [Substantial Performance of Work], submit application for payment of holdback amount in accordance with the contractual agreement.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Environmental Protection Act (CEPA):
 - .1 SOR/2008-197, Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations

1.2 ADMINISTRATIVE REQUIREMENTS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Two weeks before Substantial Performance of the Work, submit to the Consultant, final copies of operating and maintenance manuals in English.
- .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .4 Provide evidence, if requested, for type, source and quality of products supplied.

1.4 FORMAT

- .1 Organize data as instructional manual.
- .2 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .3 Arrange content by systems, process flow, under Section numbers and sequence of Table of Contents.
- .4 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .5 Text: manufacturer's printed data, or typewritten data.
- .6 Drawings: Provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.

1.5 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Table of Contents for Each Volume: provide title of project;
 - .1 Date of submission; names.
 - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
 - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: As required to supplement product data.
 - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.
- .6 Training: Refer to Section [01 79 00 - Demonstration and Training].

1.6 AS-BUILT DOCUMENTS AND SAMPLES

- .1 Maintain, in addition to requirements in General Conditions, at site for Consultant one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Site test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store record documents and samples in site office apart from documents used for construction.
 - .1 Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
 - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
 - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection Consultant.

1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Consultant.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.

- .3 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Site changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 Referenced Standards to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: Maintain manufacturer's certifications, inspection certifications, site test records, required by individual specifications Sections.
- .7 Provide digital photos, if requested, for site records.

1.8 FINAL SURVEY

- .1 Submit final site survey certificate in accordance with Section 01 71 00 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.9 EQUIPMENT AND SYSTEMS

- .1 For each item of equipment and each system include description of unit or system, and component parts.
 - .1 Give function, normal operation characteristics and limiting conditions.
 - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.

- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide [Contractor's] [Design-Builder's] coordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and Section 01 91 13 - General Commissioning Requirements.
- .15 Additional requirements: As specified in individual specification Sections.

1.10 MATERIALS AND FINISHES

- .1 Building products, applied materials, and finishes: Include product data, with catalogue number, size, composition, and colour and texture designations.
 - .1 Provide information for re-ordering custom manufactured products.
- .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.

1.11 MAINTENANCE MATERIALS

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

.5 Obtain receipt for delivered products and submit before to final payment.

.3 Special Tools:

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

1.12 DELIVERY, STORAGE, AND HANDLING

- .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 for review by Consultant.

1.13 WARRANTIES AND BONDS

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Consultant approval.
- .3 Warranty management plan to include required actions and documents to assure that Consultant receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Consultant for approval before each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by Subcontractors, suppliers, and manufacturers, within [ten] days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint 4 month and 9 month warranty inspection, measured from time of acceptance, by Consultant.

- .9 Include information contained in warranty management plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, Subcontractors, manufacturers, or suppliers involved.
 - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and] commissioned systems such as fire protection, alarm systems, sprinkler systems.
 - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.
 - .3 Location where installed.
 - .4 Name and phone numbers of manufacturers or suppliers.
 - .5 Names, addresses and telephone numbers of sources of spare parts.
 - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
 - .7 Cross-reference to warranty certificates as applicable.
 - .8 Starting point and duration of warranty period.
 - .9 Summary of maintenance procedures required to continue warranty in force.
 - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
 - .11 Organization, names and phone numbers of persons to call for warranty service.
 - .12 Typical response time and repair time expected for various warranted equipment.
 - .4 Contractor's plans for attendance at 4 and 9 month post-construction warranty inspections.
 - .5 Procedure and status of tagging of equipment covered by extended warranties.
 - .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the Consultant to proceed with action against Contractor.

1.14 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil-and water-resistant tag approved by Consultant.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate the following information on tag:
 - .1 Type of product/material.
 - .2 Model number.
 - .3 Serial number.
 - .4 Contract number.
 - .5 Warranty period.
 - .6 Inspector's signature.
 - .7 Construction Contractor.

PART 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

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

1.2 ABBREVIATIONS

- .1 AFD: Alternate Forms of Delivery, service provider
- .2 BMM: Building Management Manual
- .3 Cx: Commissioning
- .4 EMCS: Energy Monitoring and Control Systems
- .5 O&M: Operation and Maintenance
- .6 PI: Product Information
- .7 PV: Performance Verification
- .8 TAB: Testing, Adjusting and Balancing

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Consultant will observe some or all commissioning activities at their discretion.
 - .2 Owner's Performance Testing: Performance testing of equipment or systems by Consultant will not relieve Contractor from compliance with specified start-up and testing procedures.
 - .3 Cooperate fully with Consultant during stages of acceptance and occupancy of facility.
 - .4 Coordination with Authorities Having Jurisdiction (AHJ):
 - .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of AHJ, arrange for authority to witness procedures to avoid duplication of tests and to facilitate an earlier acceptance of facility.
 - .2 Obtain certificates of approval, acceptance, and compliance with rules and regulations of AHJ.
 - .3 Submit copies to Consultant within 5 days of test and with Cx report.
- .2 Commissioning Meetings:
 - .1 Hold Cx meetings after project meetings in accordance with Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM) and as indicated in this Section.
 - .2 Use Cx meetings to resolve issues, monitor progress, and identify defects and deficiencies relating to Cx.
 - .3 Continue Cx meetings on a regular basis, including during equipment start-up period, and functional testing period until commissioning deliverables have been addressed.
 - .4 At 60% construction completion stage: Consultant will request a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Agenda topics include the following:
 - .1 Review duties and responsibilities of Contractor and Subcontractors, addressing delays and potential problems.

- .2 Determine the degree of involvement of Subcontractors and manufacturer's representatives in the Cx process.
- .5 Meeting will be chaired by Cx Agent, who will record and distribute minutes.
- .6 Ensure Subcontractors and relevant manufacturer representatives are present at 60% construction completion stage, at subsequent Cx meetings, and when otherwise required.
- .3 Observation of Starting and Testing:
 - .1 Give 14 days notice before beginning commissioning.
 - .2 Consultant will observe start-up and testing.
 - .3 Cx Agent to be present at tests performed and documented by Subcontractors, suppliers, and equipment manufacturers.
- .4 Conflicts:
 - .1 Report conflicts between requirements of this Section and other Sections to Consultant and obtain interpretation or clarification before starting commissioning work.
 - .2 Failure to report conflicts and obtain interpretation or clarification will result in application of the more stringent requirement.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit no later than 4 weeks after award of Contract:
 - .1 name of Cx agent,
 - .2 draft Cx documentation, and
 - .3 preliminary Cx schedule.
 - .2 Request changes to submittals in writing to Consultant and obtain written acceptance or rejection at least 8 weeks before start of Cx.
 - .3 Where Cx procedures are not specified, submit proposed ones to Consultant and obtain written acceptance or rejection at least 8 weeks before start of Cx.
 - .4 Submit additional documentation relating to Cx process as required by Consultant.
 - .5 If instruments installed in Contract will be used for Cx of TAB and PV, then submit TAB and PV instrument calibration certificates for review and acceptance.
 - .6 Submit EMCS sensor calibration certificates.
- .2 Commissioning Schedule:
 - .1 Create and submit detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM).
 - .2 Allow in the schedule adequate time for Cx activities prescribed in technical specification Sections and commissioning Sections including:
 - .1 acceptance of Cx reports
 - .2 verification of reported results
 - .3 repairs, retesting, re-commissioning, and re-verification
 - .4 training
- .3 Start-Up Documentation:
 - .1 Assemble start-up documentation and submit to Consultant for review and acceptance before beginning commissioning.
 - .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment.
 - .2 Pre-start-up inspection reports.
 - .3 Signed installation/start-up checklists.
 - .4 Start-up reports.
 - .5 Step-by-step description of complete start-up procedures so Consultant can repeat start-up at any time.

- .4 Submit for review and acceptance:
 - .1 Complete list of proposed instruments and equipment to perform commissioning.
 - .2 List data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .5 Commissioning Documentation:
 - .1 Refer to Section 01 91 13.16 - Commissioning Forms for requirements and instructions for use.
 - .2 Submit completed Cx documentation to Consultant for review and acceptance.

1.5 MAINTENANCE MATERIALS SUBMITTALS

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

1.6 SITE CONDITIONS

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

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Perform Cx after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved.
 - .1 Objectives: Verify that installed equipment, systems and integrated systems operate in accordance with Contract Documents and design criteria and intent.

3.2 COMMISSIONING OVERVIEW

- .1 Refer to Section 01 91 13.13 - Commissioning Plan for additional Cx responsibilities.
- .2 Include Cx as a line item in Contractor's cost breakdown.
- .3 Cx activities supplement the site quality control and testing procedures described in relevant technical specification Sections.
- .4 Conduct Cx at the same time as other activities during the construction stage.

- .5 Cx identifies issues in the Design stages, which are addressed during Construction and Cx stages. This step ensures the built facility meets functional and operational requirements while operating as intended under weather, environmental and occupancy conditions. Cx activities include the transfer of critical knowledge to the Owner's facility operations personnel.
- .6 Consultant will issue Interim Acceptance Certificate only after:
 - .1 Cx documentation has been received, reviewed for suitability, and reviewed and accepted by Consultant,
 - .2 equipment, components and systems have been commissioned, and
 - .3 O&M training has been completed.

3.3 PRE-COMMISSIONING REVIEW

- .1 Before Construction:
 - .1 Review Contract Documents and confirm in writing to Consultant the following:
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
 - .1 Coordinate provision, location, and installation of provisions for Cx.
- .3 Before Beginning Cx:
 - .1 Verify Cx Plan and schedules are up-to-date.
 - .2 Verify installation of related components, equipment, systems, and sub-systems are complete.
 - .3 Review Cx requirements and procedures.
 - .4 Verify documentation used for the Cx process is shelf-ready (bound, organized, indexed, etc.).
 - .5 Review design criteria and intent, and special features to ensure full understanding.
 - .6 Submit complete start-up documentation to Consultant.
 - .7 Verify systems have been cleaned thoroughly.
 - .8 Complete TAB procedures on systems and submit TAB reports to Consultant for review and acceptance.
 - .9 Verify "As-Built" system schematics are available.
- .4 Inform Consultant in writing of defects and deficiencies in installed Work.

3.4 STARTING AND TESTING

- .1 Contractor to provide and pay costs of the following:
 - .1 inspections, including disassembly and re-assembly after approval, and for starting, testing, adjusting, and;
 - .2 temporary testing equipment.

3.5 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application Tolerances:
 - .1 A specified range of acceptable deviations of measured values from specified values or specified design criteria except for special areas that shall be within +/- 10% of specified values.
- .2 Instrument Accuracy Tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement Tolerances During Verification:
 - .1 Unless otherwise specified, actual values shall be within +/- 2% of recorded values.

3.6 MANUFACTURER SERVICES

- .1 During factory testing, manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Arrange for Consultant to observe testing.
 - .3 Submit testing documentation for review and acceptance by Consultant.
 - .4 Obtain written acceptance of test results and documentation from Consultant before delivery to site.
- .2 Obtain manufacturer's installation, start-up and operations instructions before start-up of components, equipment and systems, and review with Consultant.
 - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
 - .2 Modify procedures that may be detrimental to equipment performance and review with manufacturer before start-up.
- .3 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified in other divisions or where required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation and operation of equipment and systems.
 - .2 Ability to interpret test results accurately.
 - .3 Report results in clear, concise, logical manner.

3.7 COMMISSIONING PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in a normal and safe manner before conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in the following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, reviewed and accepted shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: Follow accepted start-up procedures.
 - .3 Operational testing: Document equipment performance.
 - .4 System PV: Include repetition of tests after correcting deficiencies.
 - .5 Post-Substantial Performance Verification: To include fine-tuning.
- .3 Correct deficiencies and obtain acceptance from Consultant after distinct phases have been completed and before beginning the next phase.
- .4 Document required tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Consultant. If evaluation report indicates that equipment start-up procedure was deficient and resulted in equipment damage, perform the following:
 - .1 Minor equipment/systems: Perform corrective measures acceptable to Consultant.
 - .2 Major equipment/systems: If evaluation report indicates that equipment damage is minor, perform corrective measures acceptable to Consultant.
 - .3 If evaluation report indicates that major equipment damage has occurred, Consultant will reject equipment.
 - .1 Remove rejected equipment from site and replace with new equipment.

- .2 Perform specified start-up procedures on new equipment/systems.

3.8 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed or recommended by equipment/system manufacturer.
- .2 With manufacturer's assistance, develop written maintenance program and submit to Consultant for review and acceptance before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

3.9 TEST RESULTS

- .1 If start-up, testing, or PV produce unacceptable results, repair, replace or repeat specified starting or PV procedures until acceptable results are achieved.
- .2 Provide labour and materials, and assume costs for re-commissioning.

3.10 START OF COMMISSIONING

- .1 Notify Consultant at least 21 days before start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

3.11 TEMPORARY INSTRUMENTS AND EQUIPMENT

- .1 Provide the following instruments and equipment as required:
 - .1 2-way radios
 - .2 ladders
 - .3 other instruments and equipment required to complete commissioning

3.12 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 under actual operating conditions, over entire operating range, and in all modes, and
 - .2 on independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 Make EMCS trending information available as supporting documentation for performance verification.

3.13 EXTENT OF VERIFICATION

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

- .2 Elsewhere:
 - .1 Provide labour and instrumentation to verify up to 30% of reported results, unless otherwise specified in other specification Sections.
- .3 Number and location to be at discretion Consultant.
- .4 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, and instrumentation.
- .5 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .6 Perform additional commissioning until results are acceptable to Consultant.

3.14 INSTALLED INSTRUMENTATION

- .1 Use instruments installed under Contract for TAB and PV if:
 - .1 Accuracy complies with this specification Section.
 - .2 Calibration certificates have been submitted to Consultant.
- .2 Calibrated EMCS sensors may be used to obtain performance data if sensor calibration has been completed and accepted.

3.15 PROCEDURES FOR DEFICIENCIES DISCOVERED DURING COMMISSIONING

- .1 Correct defects and deficiencies found during the Cx process. Re-verify equipment and components within the defective or deficient system to verify proper performance, including related systems if requested by Consultant.
- .2 Costs associated with re-commissioning defective and deficient work is the responsibility of Contractor. Above costs to be in the form of progress payment reductions or hold-back assessments.

3.16 MISCELLANEOUS CHECKS AND ADJUSTING

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

3.17 DEFICIENCIES AND DEFECTS

- .1 Correct deficiencies and defects found during start-up and Cx to satisfaction of Consultant.
- .2 Report concerns, deficiencies, and defects affecting Cx Consultant in writing. Stop Cx until problems are rectified. Proceed with written acceptance from Consultant.

3.18 CLOSEOUT ACTIVITIES

- .1 Completion of Commissioning:
 - .1 Upon completion of Cx, leave systems in normal operating mode.
 - .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx before issuance of Interim Certificate of Completion.
 - .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Consultant.

- .2 Activities Upon Completion of Commissioning:
 - .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 demolition and disposal of select site items;
 - .2 removal and reinstallation of select site items;
 - .3 removal and turn over of select site items to the Owner;
 - .4 repair and restoration work after completion of work of this section.

1.2 RELATED REQUIREMENTS

- .1 Section 02 26 00 – Hazardous Material Assessment
- .2 Section 02 41 13.13 – Paving Removal
- .3 Section 31 23 33.01 - Excavating, Trenching and Backfilling
- .4 Section 33 71 73.02 - Underground Electrical Service

1.3 PRICE AND PAYMENT PROCEDURES

- .1 Measurement and payment:
 - .1 Removal of asphalt paving, measured in square metres (m²) [for each thickness specified].
 - .2 Removal of Portland cement concrete paving, measured in square metres (m²) for each specified thickness.
 - .3 Removal of base and sub-base paving materials, measured in square metres (m²) for each specified thickness.
 - .4 Removal of concrete foundations for site items, measured in cubic metres (m³) in place.
 - .5 Removal of culverts, pipe sewers, and drains, measured in metres (m) regardless of diameter.
 - .6 Measure end points at centres of maintenance holes or catch basins, or open ends of pipes, as applicable.
 - .7 Removal of maintenance holes or catch basins, measured in complete units.
 - .8 Removal of cable duct banks, regardless of number of ducts in each bank, measured in metres (m) from end to end of duct bank.
 - .9 Removal of fences, curbs and guard rails, measured in metres (m).
 - .10 Include costs for salvage, stockpiling, sealing, disposal, recycling, excavating, backfilling, and restoration in above removal items.
 - .11 Removal of waste from site, measured in metric tonnes.

1.4 DEFINITIONS

- .1 Construction equipment: Machinery or equipment required to prepare, fabricate, move, erect or otherwise perform the Work. Does not include machinery or equipment incorporated into the Work.
- .2 Hazardous material: Controlled product and a chemical, biological, or physical agent that, by reason of a property that the agent possesses, is hazardous to the safety or health of a person exposed to it. Synonymous with the definition of hazardous substance in the Canada Labour Code.
- .3 Selective site demolition: The act of removing specific identified items from the project site, typically performed before construction work begins on site.

- .4 Waste management coordinator: In accordance with Section 01 74 19 – Waste Management and Disposal.

1.5 REFERENCE STANDARDS

- .1 Canadian Council of Ministers of the Environment (CCME):
 - .1 PN 1326-2003, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products
- .2 Employment and Social Development Canada (ESDC):
 - .1 [R.S.C., 1985, c. L-2, Canada Labour Code](#)
- .3 Health Canada (HC):
 - .1 [R.S.C. 1985, c H-3, Hazardous Products Act](#)
- .4 ULC Standards (ULC):
 - .1 CAN/ULC-S664:2017, Standard for Containment Sumps, Sump Fittings, and Accessories for Flammable and Combustible Liquids
 - .2 CAN/ULC-S679:2017, Standard for Metallic and Nonmetallic Underground Piping for Flammable and Combustible Liquids
 - .3 ANSI/CAN/UL/ULC 2583:2021, Standard for Safety, Fuel Tank Accessories for Flammable and Combustible Liquids

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-demolition meetings: Conduct a site meeting in accordance with Section 01 31 19 – Project Meetings and attended by the Consultant, the Owner, the waste management coordinator (WMC), and appropriate Subcontractors to:
 - .1 Verify project requirements, including existing construction conditions affected by work of this section, scope of selective site demolition work, demolition sequencing, and protection of in-place conditions.
 - .2 Review scheduling of utility disruptions that may affect building occupants.
 - .3 Review the Construction and Demolition Waste Management Plan (CDWMP) specified in Section 01 74 19 – Waste Management and Disposal.
 - .4 Review waste reporting requirements.
- .2 Scheduling:
 - .1 Maintain project schedule without compromising specified material diversion rates.
 - .2 Notify the Consultant of unforeseen delays, in writing.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Schedule of selective site demolition activities: In accordance with Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM).
 - .1 Indicate, at minimum:
 - .1 Detailed sequence of selective site demolition and removal work.
 - .2 Utility service interruptions.
- .3 Shop Drawings:
 - .1 Signed and sealed by a qualified professional in accordance with Section 01 43 00 – Quality Assurance.
 - .2 Selective site demolition drawings, diagrams, details, or procedure showing sequence of selective site demolition.

- .1 Locations of temporary partitions and means of egress;
- .2 Coordination of shutoff, capping, and continuation of utility services; and
- .4 Site quality control submittals:
 - .1 Pre-demolition photographs or video recordings as specified in EXAMINATION in this section.
- .5 Submit copies of the following, when required by the authority having jurisdiction (AHJ):
 - .1 reviewed Shop Drawings; and
 - .2 reviewed demolition procedures.

1.8 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and maintenance data:
 - .1 Include, in the operation and maintenance manual, manufacturer's maintenance instructions and recommended cleaning materials and methods.
 - .1 Submit maintenance and operating instructions for repair materials used in the Work.

1.9 QUALITY ASSURANCE

- .1 Licensed professional qualifications: In accordance with Section 01 43 00 – Quality Assurance.

1.10 SITE CONDITIONS

- .1 Hazardous materials are [not] expected to be encountered in the Work.
- .2 Review the [hazardous materials assessment] in accordance with [Section 00 31 00 – Available Project Information] [Section 02 26 00 – Hazardous Material Assessment].
- .3 Stop work immediately and take preventative measures if hazardous materials are encountered.
 - .1 Notify the Consultant immediately.
 - .2 Proceed with work after receipt of written instructions from the Consultant.

PART 2 PRODUCTS

2.1 MATERIAL OWNERSHIP

- .1 Coordinate material ownership with the Owner.
- .2 The Owner will retain ownership of:
 - .1 items to remain;
 - .2 items to be reused;
 - .3 items to be reinstalled;
 - .4 items to be removed and turned over to the Owner;
 - .5 historic items, relics, and similar objects;
 - .6 cornerstones and their contents;
 - .7 commemorative plaques and tablets;
 - .8 antiques;
 - .9 other items of interest or value to the Owner that may be encountered during demolition.
- .3 Take possession of demolished materials and remove from site.

2.2 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 as closely as possible.
 - .2 Use materials whose installed performance equals or surpasses that of existing materials.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 – Examination and Preparation, and:
 - .1 Review existing conditions and coordinate with indicated requirements to determine extent of demolition required.
 - .2 Photograph or video record existing conditions of adjoining construction and site improvements before starting selective site demolition. Include finish surfaces that may be misconstrued as damage caused by work of this section.
 - .3 Review record documents of existing site available from the Owner.
 - .1 The Owner or Consultant does not guarantee record documents are accurate, complete, or appropriate.
 - .4 Appoint a professional engineer to perform an engineering review of building conditions to determine whether removing any element might result in structural deficiency, deformation, or unplanned collapse of any portion of adjacent buildings or structures during demolition operations.
 - .5 Verify Hazardous Materials have been [[abated] [or] [remediated]] before proceeding with work of this section.

3.2 PREPARATION

- .1 Protection of in-place conditions:
 - .1 Provide temporary controls, in accordance with Section 01 57 00 – Temporary Controls, to protect adjacent watercourses, groundwater, and wildlife, and to mitigate excess air-and noise pollution.
 - .1 Prevent debris from blocking surface drainage systems, [elevators,] and mechanical-or electrical systems to remain in operation.
 - .2 Provide dust-tight screens or partitions in accordance with Section 01 56 00 – Temporary Barriers and Enclosures.
 - .3 Provide bracing, shoring, and underpinning as required.
 - .2 Support affected site items and, if safety of site item being demolished or adjacent structures or services appears to be endangered, take preventative measures, stop working, and immediately notify the Consultant.
- .2 Existing services:
 - .1 Disconnect and reroute electrical and service lines within the site.
 - .1 Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of selective site demolition.
 - .2 Disconnect and cap designated mechanical services.
 - .1 Natural gas supply lines: Remove in accordance with gas company requirements.
 - .2 Sewer and water lines: Remove in accordance with AHJ requirements.
 - .3 Other underground services: Remove and dispose of as indicated on Drawings.
 - .3 Disruption of active or energized utilities designated to remain undisturbed is not permitted.

3.3 CONSTRUCTION EQUIPMENT EMISSION MANAGEMENT

- .1 Minimize construction equipment emissions while performing work of this section.
- .2 Shut down construction equipment when not in use, except where extreme temperatures prohibit shutting Construction Equipment.

3.4 DEMOLITION

- .1 Demolish items as required to facilitate new construction.
- .2 Demolish pavements, curbs, and gutters:
 - .1 Square up adjacent surfaces to remain in place by saw cutting or other method producing a smooth, straight edge.
 - .2 Protect adjacent joints and load transfer devices.
 - .3 Protect underlying and adjacent granular materials.
- .3 Trees: Remove the minimum number of trees required to perform the Work.
 - .1 Obtain written approval of the Consultant before removing trees not designated for removal.

3.5 REMOVAL AND REINSTALLATION

- .1 Remove items indicated on the Drawings.
 - .1 Asphalt pavement: Prevent contamination with base-course aggregates, when removing asphalt pavement for subsequent incorporation into hot-mix asphalt paving, in accordance with Section 02 41 13.13 – Paving Removal.
- .2 Examine removed items. Confirm Consultant's acceptance for reinstallation if removed items appear in poor condition.
- .3 Temporarily store, protect, and prepare removed items for reuse.
 - .1 Stockpiling:
 - .1 Label stockpiles; indicate material types and quantities.
 - .2 Stockpile materials in convenient location for use in new construction to eliminate double handling wherever possible.
 - .3 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.
 - .4 Stockpile topsoil for final grading and landscaping.
 - .1 Provide erosion control of stockpile and seeding if not immediately used.
- .4 Reinstall removed items as indicated on the Drawings.

3.6 RESTORATION

- .1 Backfill: Backfill areas, as indicated, in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Restore areas and existing work outside areas of demolition to conditions that existed before beginning of Work.
- .3 Use soil treatments and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.
- .4 Repair damage caused by work of this section to satisfaction of the Consultant.

3.7 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning, and:
 - .1 Remove debris, trim surfaces, and leave work site clean, upon completion of work.
 - .2 Use cleaning materials and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses, or ground water.
- .2 Waste management:
 - .1 Manage waste in accordance with Section 01 74 19 – Waste Management and Disposal, and:
 - .1 Remove stockpiled material [designated for removal] when it interferes with the Work.
 - .2 Remove stockpiles of like materials designated for removal and alternate disposal option once material collection is complete.
 - .3 Disposal of waste of volatile materials, including mineral spirits, oil, petroleum-based lubricants, or toxic cleaning solutions into watercourses, or storm-or sanitary sewers, is not permitted.
 - .4 Vegetation:
 - .1 Trees: Divert from landfill trees as indicated on Drawings.
 - .2 Other vegetation: Grind, chip, or shred for mulching and composting.
 - .5 Trim disposal areas.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section includes descriptions for demolishing, salvaging, recycling and removing of asphalt paving identified in whole or in part, and for backfilling trenches and excavations resulting from site demolition activities as required by scope of work.

1.2 RELATED REQUIREMENTS

- .1 Section 02 41 13 - Selective Site Demolition
- .2 Section 02 41 16 - Structure Demolition

1.3 PRICE AND PAYMENT

- .1 Removal of existing asphalt pavement will be measured in square metres of surface actually removed regardless of depth removed, regardless of number of operations required.
- .2 Payment under this item will include operations involved in removing, hauling and stockpiling designated pavement and cleaning of remaining pavement surface.

1.4 REFERENCE STANDARDS

- .1 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act, 1999 (CEPA), c. 33.
- .2 United States Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.5 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 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
- .3 Draft Construction Waste Management Plan (Draft CWM Plan): Detailed inventory of materials in building indicating estimated quantities of reuse, recycling and landfill, prepared in accordance with Section 01 74 19 - Construction Waste Management and Disposal and as follows:
 - .1 Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project.
- .4 Waste Management Coordinator (WMC): Contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .5 Construction Waste Management Plan (CWM Plan): Written plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal.

- .6 Construction Waste Management Report (CWM Report): Written report identifying actual materials that formed CWM Plan for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate requirements for Waste Management and Disposal for materials being re used or recycled in accordance with Section 01 74 19 - Waste Management and Disposal:
 - .1 Divert excess materials from landfill
 - .2 Separate materials identified for recycling place in identified areas in accordance with Waste Management Plan
 - .3 Label location of salvaged material's storage areas and provide barriers and security devices
 - .4 Remove materials that cannot be salvaged for re use or recycling and dispose of in accordance with applicable codes at licensed facilities
- .2 Pre Construction Meeting: Arrange a pre-construction meeting in accordance with Section 01 31 19 - Project Meetings; attended by Representative, Consultant, Contractor's key personnel, waste management coordinator and Consultant to discuss the following:
 - .1 Verify project requirements.
 - .2 Review site conditions.
 - .3 Coordination with other Subcontractor]'s affected by work of this Section.
 - .4 Examine existing site conditions adjacent to demolition work, prior to start of Work.
 - .5 Waste reporting requirements.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide following submittals before starting work of this Section:
 - .1 Shop Drawings: Submit shop drawings indicating diagrams or details showing sequence of demolition work.
- .2 Informational Submittals: Provide following submittals during course of work:
 - .1 Certificates: Submit copies of certified weigh bills, bills of lading or receipts from authorized disposal sites and re use and recycling facilities for material removed from site on [weekly][monthly] basis.
- .3 Sustainable Design Submittals:
 - .1 Erosion and Sedimentation Control: submit copy of erosion and sedimentation control plan in accordance with EPA 832/R-92-2005, authorities having jurisdiction.
 - .2 Construction Waste Management: Submit project [CWM Plan] highlighting recycling and salvage requirements in accordance with Section 01 74 19 - Waste Management and Disposal, and as follows:

1.8 QUALITY ASSURANCE

- .1 Regulatory Requirements: ensure Work is performed in compliance with CEPA, CEAA, TDGA, applicable Provincial/Territorial regulations.
 - .2 Comply with hauling and disposal regulations of Authority Having Jurisdiction.
-

1.9 SITE CONDITIONS

- .1 Protect existing site features to remain or identified for salvage or re use; make repairs and restore to a similar condition to existing where damage to these items occurs as directed by Consultant and at no cost to Owner:
 - .1 Remove and store salvaged materials to prevent contamination.
 - .2 Store and protect salvaged materials as required for maximum preservation of material.
 - .3 Handle salvaged materials same as new materials.
- .2 Perform pavement removal work to prevent adverse effects to adjacent watercourses, groundwater and wildlife, and to prevent excess air and noise pollution:
 - .1 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers or onto adjacent properties.
 - .2 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with Authorities Having Jurisdiction.
 - .3 Protect existing site features and structures, trees, plants and foliage on site and adjacent properties.

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 Use cold milling, planning or grinding equipment with automatic grade controls capable of operating from stringline, and capable of removing part of pavement surface to depths or grades indicated.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Verify extent and location of asphalt identified for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Locate and protect utilities, preserve active utilities traversing site in operating condition.
- .3 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 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .4 Prior to beginning removal operation, inspect and verify with Departmental Representative areas, depths and lines of asphalt pavement to be removed.
- .5 Protection: protect existing pavement not designated for removal, light units and structures from damage. In event of damage, immediately replace or make repairs to approval of Departmental Representative at no additional cost.

3.2 REMOVAL

- .1 Remove existing asphalt pavement to lines and grades as indicated.

- .2 Demolition of pavements, curbs and gutters:
 - .1 Square up adjacent surfaces to remain in place by saw cutting or other method acceptable to Representative.
 - .2 Protect adjacent joints and load transfer devices.
 - .3 Protect underlying and adjacent granular materials where they are exposed and identified to remain.
 - .4 Prevent contamination with base course aggregates, when removing asphalt pavement for subsequent incorporation into hot mix asphalt concrete paving.
- .3 Use equipment and methods of removal and hauling which do not damage or disturb underlying pavement.
- .4 Prevent contamination of removed asphalt pavement by topsoil, underlying gravel or other materials.
- .5 Suppress dust generated by removal process.

3.3 FINISH TOLERANCES

- .1 Finished surfaces in areas where asphalt pavement has been removed within +/-5 mm of grade specified but not uniformly high or low.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .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 - Cleaning.
- .3 Sweep remaining asphalt pavement surfaces clean of debris resulting from removal operations using rotary power brooms and hand brooming as required.
- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
 - .2 Removed asphalt pavement which is to be recycled in hot mix asphalt concrete under this contract may be stockpiled at designated asphalt plant site.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 This section includes requirements for the following:
 - .1 Demolition and removal of buildings and structures.
 - .2 Demolition and removal of site improvements adjacent to a building or structure being demolished.
 - .3 Demolition and removal of concrete foundations.
 - .4 Removing below grade construction.
 - .5 Disconnecting, capping or sealing, and removing site utilities.
- .2 This section does not include for the removal of Hazardous Substances or asbestos abatement, or selective demolition of interior building components and finishes.
- .3 Drawings contain details that suggest directions for solving some of the major demolition and removal requirements for this Project ; Contractor representative is required to develop these details further by submitting a demolition plan prepared by a professional engineer.

1.2 RELATED REQUIREMENTS

- .1 Section 02 81 00 - Transportation and Disposal of Hazardous Materials
- .2 Section 31 05 16 - Aggregates for Earthwork
- .3 Section 33 71 73.02 - Underground Electrical Service

1.3 DEFINITIONS

- .1 Demolition: Rapid destruction of building following removal of Hazardous Substances.
- .2 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products, may include but not limited to: asbestos PCB's, CFC's, HCFC's poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the federal Hazardous Products Act including latest amendments.
- .3 Waste Management Coordinator: Contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .4 Draft Construction Waste Management Plan: Detailed inventory of materials in building indicating estimated quantities of reuse, recycling and landfill, prepared in accordance with Section 01 74 19 - Waste Management and Disposal and involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project.
- .5 Construction Waste Management Plan: Written plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal.
- .6 Construction Waste Management Report: Written report identifying actual materials that formed Construction Waste Management Plan for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal.

1.4 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA S350-M1980, Code of Practice for Safety in Demolition of Structures
- .2 Department of Justice Canada (Jus):
 - .1 Canadian Environmental Protection Act (CEPA), 1999
 - .1 SOR/2003-2, On-Road Vehicle and Engine Emission Regulations
 - .2 SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission Regulations
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34
 - .4 Motor Vehicle Safety Act (MVSA), 1995
 - .5 Hazardous Substances Information Review Act, 1985
 - .2 Hazardous Products Act, RSC 1985, c H-3
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 241-21, Standard for Safeguarding Construction, Alteration, and Demolition Operations

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with Owner for the material ownership as follows:
 - .1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from project site.
 - .2 Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during demolition remain Owner's property:
 - .1 Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.
 - .2 Coordinate with Owner's historical adviser, who will establish special procedures for removal and salvage operations.
- .2 Pre-Demolition Meetings:
 - .1 Convene pre-Demolition meeting 1 week before beginning work of this section, with Contractor and Consultant in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify project requirements.
 - .2 Verify existing site conditions adjacent to demolition work.
 - .3 Coordination with other construction subtrades.
 - .2 Hold project meetings every week.
 - .3 Ensure key personnel, site supervisor, project manager, Subcontractor, WMC attend.
 - .4 WMC must provide written report on status of waste diversion activity at each meeting.
 - .5 Consultant will provide written notification of change to meeting schedule established upon contract award 24 hours before scheduled meeting.
- .3 Scheduling:
 - .1 Employ necessary means to meet project time lines without compromising specified minimum rates of material diversion.
 - .1 In event of unforeseen delay notify Consultant in writing.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Action Submittals: Provide the following submittals before starting any work of this section:
 - .1 Shop Drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario:
 - .1 Submit for review and approval demolition drawings, diagrams or details showing sequence of demolition work and supporting structures and underpinning.
 - .2 Waste Management Coordinator is responsible for fulfilment of reporting requirements.
 - .3 Schedule of Demolition Activities: Coordinate with Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM), and indicate:
 - .1 Detailed sequence of 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
 - .4 Locations of temporary partitions and means of egress
 - .4 Demolition plan: Submit a plan of demolition area indicating extent of temporary facilities and supports, methods of removal and demolition prepared by a professional engineer in accordance with requirements of authority having jurisdiction.
 - .5 Inventory: Submit a list of items that have been removed and salvaged after demolition is complete.
 - .1 Landfill records: Indicate receipt and acceptance of [hazardous wastes by a landfill facility licensed to accept hazardous wastes].
 - .2 Pre-demolition photographs or videotape: Submit photographs or videotape indicating existing conditions of adjoining construction and site improvements before starting Work. Include finish surfaces that may be misconstrued as damage caused by demolition operations.
- .3 Informational Submittals: Provide the following submittals when requested:
 - .1 Certificates: Submit statement of refrigerant recovery as follows:
 - .1 Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to regulations of authority having jurisdiction.
 - .2 Include name and address of technician and date refrigerant was recovered.
 - .2 Qualification data: Submit information for companies and personnel indicating their capabilities and experience to perform work of this section.

1.7 QUALITY ASSURANCE

- .1 Regulatory Requirements: Ensure Work is performed in compliance with CEPA, CEAA, TDGA, and applicable provincial/territorial and municipal regulations.
 - .1 Comply with hauling and disposal regulations of authority having jurisdiction.
 - .2 Standards: Comply with ANSI A10.6 and NFPA 241

1.8 SITE CONDITIONS

- .1 Environmental Protection:
 - .1 Ensure work is done in accordance with Section 01 35 43 - Environmental Procedures.
 - .2 Ensure work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
 - .3 Fires and burning of waste or materials is not permitted on site.
 - .4 Do not bury rubbish waste materials.
 - .5 Do not dispose of waste or volatile materials including but not limited to: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
 - .6 Ensure proper disposal procedures are maintained throughout Project.

- .2 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.
- .3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with authorities having jurisdiction.
- .4 Protect trees, plants and foliage on site and adjacent properties where indicated.
- .5 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during demolition work.
- .6 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on all temporary roads.
- .7 Owner will occupy another building immediately adjacent to demolition area.
- .8 Conduct structure demolition so Owner's operations will not be disrupted:
 - .1 Provide not less than 72 hours' notice to Owner of activities that will affect operations.
 - .2 Maintain access to existing walkways, exits, and other adjacent occupied or used facilities:
 - .1 Do not close or obstruct walkways, exits, or other occupied or used facilities without written permission from authority having jurisdiction.
- .9 Consultant assumes no responsibility for buildings and structures being demolished:
 - .1 Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - .2 Remove, protect, and store salvaged items as directed by Consultant before structure demolition.
 - .3 Salvage items as identified by Consultant.
 - .4 Deliver to Owner as directed.

1.9 EXISTING CONDITIONS

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition on date that tender is accepted.
 - .1 Existing Hazardous Substances: Owner has performed a hazardous substances assessment and identified materials requiring abatement as follows:
 - .1 Hazardous Substances are as defined in the Hazardous Products Act.
 - .2 Hazardous Substances will be removed by the Contractor as a part of the Contract before starting Work in accordance with work results described in Related Requirements listed above.
- .2 Discovery of Hazardous Substances: Immediately notify Consultant if materials suspected of containing Hazardous Substances are encountered and perform the following activities:
 - .1 Hazardous Substances will be as defined in the Hazardous Products Act.
 - .2 Stop work in the area of the suspected Hazardous Substances.
 - .3 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
 - .4 Proceed only after written instructions have been received from Consultant.

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 Equipment and Heavy Machinery:
 - .1 On-road vehicles to: CEPA-SOR/2003-2, On-Road Vehicle and Engine Emission Regulations and CEPA-SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission Regulations.
 - .2 Off-road vehicles to: EPA CFR 86.098-10 and EPA CFR 86.098-11.
 - .3 Leave machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

2.2 TEMPORARY SUPPORT STRUCTURES

- .1 Design temporary support structures required for demolition work and underpinning and other foundation supports necessary for the Project using a qualified professional engineer registered or licensed in Province of Ontario of the Work.

2.3 SOIL MATERIALS

- .1 Satisfactory Soils: Provide soil in accordance with Section 31 05 16 - Aggregates for Earthwork.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Survey existing conditions and correlate with requirements indicated to determine extent of structure demolition required.
 - .2 Review project record documents of existing construction provided by Consultant.
 - .3 Consultant does not guaranty existing conditions are the same as those indicated in project record documents.
 - .4 Inventory and record the condition of items being removed and salvaged.
 - .5 When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element.
 - .6 Promptly submit a written report to Consultant.
 - .7 Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during structure demolition operations.
 - .8 Verify Hazardous Substances have been remediated before proceeding with structure demolition operations.
-

3.2 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Work in accordance with Section 01 35 43 - Environmental Procedures and Erosion and Sedimentation Control Plan.
 - .2 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, adjacent grades, properties.
 - .1 Provide bracing, shoring as required.
 - .2 Repair damage caused by demolition as directed by Consultant.
 - .3 Support affected structures and, if safety of structure being demolished or adjacent structures or services appears to be endangered, take preventative measures, stop Work and immediately notify Consultant and Owner.
 - .4 Prevent debris from blocking surface drainage system, mechanical and electrical systems which must remain in operation.
- .2 Surface Preparation:
 - .1 Disconnect and re-route electrical and telephone service lines entering buildings to be demolished.
 - .1 Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of demolition.
 - .2 Disconnect and cap designated mechanical services.
 - .1 Natural gas supply lines: remove in accordance with gas company requirements.
 - .2 Sewer and water lines: remove in accordance with authority having jurisdiction.
 - .3 Other underground services: remove and dispose of as directed by Consultant in accordance with Section 33 71 73.02 - Underground Electrical Service.
 - .3 Do not disrupt active or energized utilities designated to remain undisturbed.
 - .4 Remove rodents and vermin.

3.3 DEMOLITION

- .1 Protect demolition work in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
- .2 Blasting operations not permitted during demolition.
- .3 Remove contaminated or dangerous materials as defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.
- .4 Before start of Work remove contaminated or hazardous materials listed as hazardous from site and dispose of at designated disposal facilities in safe manner and in accordance with TDGA and other applicable requirements and Section 02 81 00 - Transportation and Disposal of Hazardous Materials. Refer to EXISTING CONDITIONS in PART 1.
- .5 Demolish structure.
- .6 Crush concrete generated due to demolition of foundations to size suitable for recycling.
 - .1 Where possible identify markets which will accept crushed material as aggregate.
 - .2 For further information regarding acceptable uses contact Provincial/Territorial aggregate producers associations.
- .7 Demolish foundation walls and footings, and concrete floors below or on grade.
- .8 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as work progresses.

- .9 At end of each day's work, leave Work in safe and stable condition.
- .10 Demolish to minimize dusting. Keep materials wetted as directed by Consultant.
- .11 Remove structural framing.
- .12 Contain fibrous materials to minimize release of airborne fibres while being transported within facility.
- .13 Only dispose of material specified by selected alternative disposal option as directed by Consultant.
- .14 Additional disposal options to be provided by Consultant's, on-site waste diversion representative before disposal.
- .15 Remove and dispose of demolished materials except where noted otherwise and in accordance with authorities having jurisdiction.
- .16 Use natural lighting to do Work where possible.
 - .1 Shut off lighting except those required for security purposes at end of each day.

3.4 SITE RESTORATION

- .1 Below Grade Areas: Completely fill below grade areas and voids resulting from structure demolition operations with satisfactory soil materials according to backfill requirements in Section 31 05 16 - Aggregates for Earthwork.
- .2 Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes.
- .3 Provide a smooth transition between adjacent existing grades and new grades.

3.5 REPAIRS

- .1 General: Promptly repair damage to adjacent construction caused by structure demolition operations.
- .2 Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
- .3 Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.6 CLEANING

- .1 Develop Construction Waste Management Plan related to work of this section and in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
- .3 Divert excess materials from landfill to site approved by Consultant].
- .4 Designate appropriate security resources/measures to prevent vandalism, damage and theft.
- .5 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.

- .1 Label stockpiles, indicating material type and quantity.
- .6 Separate from general waste stream each of following materials. Stockpile materials in neat and orderly fashion in location and as directed by Consultant for alternate disposal. Stockpile materials in accordance with applicable fire and safety regulations.
 - .1 Glass fibre ceiling tiles.
 - .2 Wood fibre ceiling tiles.
 - .3 Power source poles deemed unfit for reuse by Consultant.
 - .4 Wiring and conduit.
 - .5 Outlets/switches.
 - .6 Floor receptacles.
 - .7 Metal duct work, baffles, HVAC equipment.
 - .8 Demountable partitions.
 - .9 Tracks and blinds.
 - .10 Insulation batts.
 - .11 Miscellaneous metals.
 - .12 Carpet.
- .7 Supply separate, clearly marked disposal bins for categories of waste material. Please notify [Consultant before removal of bins from site.
- .8 Remove stockpiled material as directed by Consultant, when it interferes with operations of project construction.
- .9 Remove stockpiles of like materials by alternate disposal option once collection of materials is complete.
- .10 Transport material designated for alternate disposal using approved haulers, facilities, receiving organizations listed in Waste Reduction Workplan and in accordance with applicable regulations.
 - .1 Written authorization from Consultant is required to deviate from haulers, facilities, receiving organizations listed in Waste Reduction Workplan.
- .11 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.
 - .1 Disposal facilities must be those approved of and listed in Waste Reduction Workplan.
 - .2 Written authorization from Consultant is required to deviate from disposal facilities listed in Waste Reduction Workplan.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete
- .2 Section 09 30 13 - Ceramic Tiling
- .3 Section 09 65 16 - Resilient Sheet Flooring
- .4 Section 09 65 19 - Resilient Tile Flooring
- .5 Section 09 68 13 - Tile Carpeting
- .6 Section 09 91 23 – Interior Painting

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C309-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - .2 ASTM C979/C979M-16, Standard Specification for Pigments for Integrally Colored Concrete
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors
- .3 CSA Group (CSA):
 - .1 CSA A23.1:19/A23.2:19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
- .4 South Coast Air Quality Management District (SCAQMD):
 - .1 SCAQMD Rule 1113-2016, Architectural Coatings

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with Section 03 30 00 - Cast-in-Place Concrete for wet curing.
 - .2 Coordinate concrete curing accelerators with integral concrete colour material to avoid detrimental chemical interactions.
 - .3 Coordinate concrete curing agents, to ensure compatibility with subsequently applied floor finishes and with the minimum substrate conditions of Section 09 30 13 - Ceramic Tiling, 09 65 16 - Resilient Sheet Flooring, 09 65 19 - Resilient Tile Flooring, 09 68 13 - Tile Carpeting.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product literature and data sheets for concrete finishing products. Include product characteristics, performance criteria, and resulting finishes, and limitations.
 - .2 Submit WHMIS Safety Data Sheet (SDS).

- .3 Samples:
 - .1 Samples for Verification:
 - .1 Submit a minimum 100-mm-long by 100-mm-wide concrete sample with applied sealing compound illustrating colour and gloss level.
- .4 Manufacturers' Instructions: Submit application instructions for each concrete floor treatment.
- .5 Qualification Statements:
 - .1 Submit written declaration that concrete floor finishing products used on this Project are compatible with subsequently installed finish flooring products and adhesives.

1.5 QUALITY ASSURANCE

- .1 Quality Assurance: Perform in accordance with Section 01 43 00 - Quality Assurance.
- .2 Submit proposed quality control procedures a minimum of 4 weeks before starting concrete finishing work for review by Consultant on the following items:
 - .1 Curing
- .3 Mock-Ups: Provide site mock-up for each concrete finish in accordance with Section 01 43 00 - Quality Assurance.
 - .1 Build mock-up approximately 1 m by 1 m at the project site.
 - .2 Mock-up may form part of permanent structure when accepted by Consultant.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 SITE CONDITIONS

- .1 Temporary lighting: Minimum 1200 W light source, placed 2.5 m above floor surface for each 40 m² of floor being treated.
- .2 Make work area watertight and protected against rain and detrimental weather conditions.
- .3 Temperature: Maintain a minimum 10°C ambient temperature for seven days before installation and a minimum 48 hours after completion of work. Maintain relative humidity at a maximum 40% during both periods.
- .4 Moisture: Ensure concrete substrate is within moisture limits prescribed by manufacturer.
- .5 Ventilation: Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
 - .1 Provide continuous ventilation during and after application of coating.

PART 2 PRODUCTS

2.1 CURING COMPOUNDS

- .1 To ASTM C309, waterborne, wax-free, penetrating, non-film forming, dries clear, and does not prevent adhesion with subsequently applied coatings, treatments, or other floor finishes.
- .2 Curing/sealing compound: clear, breathable, high-performance 100% silane sealer with an oleophobic additive.
 - .1 Average dept of penetration: 5 mm.
 - .2 Standard of Acceptance: Master Protect H 1000 by BASF
 - .3 Acceptable alternate: W. R. Meadows PENTREAT 244-100

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 – Examination and Preparation, and:
 - .1 Verify that concrete slabs are ready to receive work and elevations as indicated on Drawings as recommended by manufacturer's written instructions.

3.2 PLAIN FLOOR FINISH (UNEXPOSED)

- .1 Roll or tamp concrete to force coarse aggregate into concrete mix, then screed.
- .2 Float surface with wood or metal float or with power finishing machine and bring surface to true elevation.
- .3 Steel trowel to smooth and even surface.
- .4 Follow with second steel trowelling to produce smooth burnished surface to within 6mm tolerance when measured in any direction using 3m straight edge. Do not overtrowel.
- .5 Sprinkling of dry cement or dry cement and sand mixture over concrete surfaces is not acceptable.
- .6 Apply curing compound in accordance with manufacturer's instructions. Do not use curing compound when slab is to receive bonded finish. Damp curing or other approved method shall then be employed.
- .7 Sawcut crack-control joints in slabs on grade to CAN/CSA-A23.1-94 (maximum 24 hours after placement), or as noted on drawings. Seal with joint filler.
- .8 After curing and when concrete is dry; seal control joints and joints at junction with vertical surfaces with sealant.
- .9 Coordinate with Division 9 requirements.

3.3 FLOOR FINISH (EXPOSED)

- .1 Finish concrete floors as per Paragraph 3.2, Clauses .1 to .5, and apply floor hardener at a rate of 3 kg/m2 to manufacturer's instructions.
- .2 Apply approved curing/sealing compound to manufacturer's instructions.

- .3 Sawcut crack-control joints in slabs on grade to CAN/CSA-A23.1-94 (maximum 24 hours after placement), or as noted on drawings. Seal with joint filler. Coordinate with placement of radiant in-slab heating pipes.
- .4 After curing/sealing and when concrete is dry, seal control joints and joints at junction with vertical surfaces with sealant.
- .5 Clean surfaces and apply second coat curing/sealing compound before final completion.

3.4 PROTECTION

- .1 Protect finished surfaces in accordance with manufacturer's recommendations.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-A165 Series-14, Standards on Concrete Masonry Units.
 - .2 CSA A179-14, Mortar and Grout for Unit Masonry.
 - .3 CSA-A371-14, Masonry Construction for Buildings.
- .2 International Masonry Industry All-Weather Council (IMIAC)
 - .1 Recommended Practices and Guide Specification for Hot and Cold Weather Masonry Construction.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Sequencing: sequence with other work in accordance with Construction Progress Schedule - Critical Path Method (CPM) and Construction Progress Schedules - Bar Chart. Comply with manufacturer's written recommendations for sequencing construction operations.
- .2 Scheduling: schedule with other work in accordance with Construction Progress Schedule - Critical Path Method (CPM) and Construction Progress Schedules - Bar Chart.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, limitations and colours.
 - .2 Provide two copies of Workplace Hazardous Materials Information System (WHMIS) - Safety Data Sheets (SDS). Health and Safety Requirements and Environmental Procedures.
- .3 Samples:
 - .1 Provide samples as follows:
 - .1 Three of each type of masonry units specified.
 - .2 Three cured, coloured samples of mortar and grout, illustrating mortar colour and colour range, supplemented with specific requirements in Section 04 05 12 - Masonry Mortar and Grout.
 - .3 Three of each type of masonry accessory and flashing specified, supplemented by specific requirements in Section 04 05 23 - Masonry Accessories.
 - .4 Three of each type of masonry anchorage, reinforcement and connector proposed for use, supplemented by specific requirements in Section 04 05 19 - Masonry Anchorage and Reinforcing.
 - .5 Samples: used for testing and when accepted become standard for material used.
- .4 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Provide shop drawings detailing temporary bracing required, designed to resist wind pressure and lateral forces during installation.

1.4 INFORMATION SUBMITTALS

- .1 Certificates: provide manufacturer's product certificates certifying materials comply with specified requirements.
- .2 Test and Evaluation Reports:
 - .1 Provide certified test reports for Consultants.
 - .2 Test reports to certify compliance of masonry units and mortar ingredients with specified performance characteristics and physical properties.
 - .3 Provide data for masonry units, in addition to requirements set out in referenced CSA and ASTM Standards, indicating initial rates of absorption.
- .3 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, safety and cleaning.
- .4 Manufacturer's Reports: provide written reports prepared by manufacturer's on-site personnel to include:
 - .1 Verification of compliance of work with Contract.
 - .2 Site visit reports providing detailed review of installation of work, and installed work.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 EXTRA MATERIALS

- .1 Provide manufacturer's instructions in accordance with Section 01 78 00 - Closeout Submittals covering maintenance requirements and parts catalogue, with cuts and identifying numbers.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer: capable of providing field service representation during construction and approving application method.
 - .2 Installer: experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
 - .3 Masons: company or person specializing in masonry installations with 5 years documented experience with masonry work similar to this project.
 - .1 Masons employed on this project must demonstrate ability to reproduce mock-up standards.
- .2 Mock-ups:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .2 Construct mock-up panel of exterior interior masonry wall construction 1200 x 1800 mm showing masonry colours and textures, use of reinforcement, ties, through-wall flashing, weep holes, jointing, coursing, mortar and workmanship.
 - .3 Mock-up used:
 - .1 To judge workmanship, substrate preparation, operation of equipment and material application.
 - .2 For testing to determine compliance with performance requirements. Perform following tests.
 - .1 For clay units, in addition to requirements set out in referenced CSA and ASTM Standards include data indicating initial rate of absorption.

- .4 Construct mock-up where directed.
- .5 Allow 24 hours for inspection of mock-up by Consultant before proceeding with work.
- .6 When accepted by Consultant, mock-up will demonstrate minimum standard for this work. Mock-up may not remain as part of finished work.
- .7 Start work only upon receipt of written acceptance of mock-up by Consultant. Products.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Storage and Handling Protection:
 - .1 Keep materials dry until use except where wetting of bricks is specified.
 - .2 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

1.9 SITE CONDITIONS

- .1 Ambient Conditions: assemble and erect components when temperatures are above 4 degrees C.
- .2 Weather Requirements: to CSA-A371 and IMIAC - Recommended Practices and Guide Specifications for Hot and Cold Weather Masonry Construction.
- .3 Cold weather requirements:
 - .1 To CSA-A371 with following requirements.
 - .1 Maintain temperature of mortar between 5 degrees C and 50 degrees C until batch is used or becomes stable.
 - .2 Maintain ambient temperature of masonry work and it's constituent materials between 5 degrees C and 50 degrees C and protect site from windchill.
 - .3 Maintain temperature of masonry above 0 degrees C for minimum of 28 days, after mortar is installed.
 - .4 Preheat unheated wall sections in enclosure for minimum 72 hours above 10 degrees C, before applying mortar.
- .4 Hot weather requirements:
 - .1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
 - .2 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.
- .5 Spray mortar surface at intervals and keep moist for maximum of three days after installation.

1.10 WARRANTY

- .1 For Work in this Section 04 05 00 - Common Work Results for Masonry, 12 months warranty period is extended to 24 months.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- .1 Ensure manufacturer has minimum 5 years experience in manufacturing components similar to or exceeding requirements of project.

2.2 MATERIALS

- .1 Masonry materials are specified in Masonry Sections.

PART 3 EXECUTION

3.1 INSTALLERS

- .1 Experienced and qualified masons to carry out erection, assembly and installation of masonry work.

3.2 MANUFACTURER'S INSTRUCTION

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.3 EXAMINATION

- .1 Examine conditions, substrates and work to receive work of this Section.
- .2 Examine openings to receive masonry units. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.
 - .1 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation after unacceptable conditions have been remedied and after receipt of written approval from Consultant.
- .3 Verification of Conditions:
 - .1 Verify that:
 - .1 Substrate conditions which have been previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer's instructions prior to installation of Masonry units.
 - .2 Field conditions are acceptable and are ready to receive work.
 - .3 Built-in items are in proper location, and ready for roughing into masonry work.
 - .2 Commencing installation means acceptance of substrates.

3.4 PREPARATION

- .1 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations.
- .2 Establish and protect lines, levels, and coursing.
- .3 Protect adjacent materials from damage and disfiguration.

3.5 INSTALLATION

- .1 Do masonry work in accordance with CSA-A371 except where specified otherwise.

- .2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CSA-A371.
- .3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.6 CONSTRUCTION

- .1 Exposed masonry:
 - .1 Remove chipped, cracked, and otherwise damaged units, in accordance with CSA A-165, in exposed masonry and replace with undamaged units.
- .2 Jointing:
 - .1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints where concave joints are indicated.
 - .2 Allow joints to set just enough to remove excess water, then rake joints uniformly to 6 mm depth and compress with square tool to provide smooth, compressed, raked joints of uniform depth where raked joints are indicated.
 - .3 Strike flush joints concealed in walls and joints in walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.
- .3 Cutting:
 - .1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.
 - .2 Make cuts straight, clean, and free from uneven edges.
- .4 Building-In:
 - .1 Build in items required to be built into masonry.
 - .2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
 - .3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.
- .5 Wetting of masonry units:
 - .1 Except in cold weather, wet bricks having initial rate of absorption exceeding 1 g/minute/1000 mm²: wet to uniform degree of saturation, 3 to 24 hours before laying, and do not lay until surface dry.
 - .2 Wet tops of walls built of bricks qualifying for wetting, when recommencing work on such walls.
- .6 Support of loads:
 - .1 Use grout to CSA A179 where grout is used in lieu of solid units.
 - .2 Install building paper below voids to be filled with grout; keep paper 25 mm back from faces of units.
- .7 Provision for movement:
 - .1 Leave 3 mm space below shelf angles.
 - .2 Leave 6 mm space between top of non-load bearing walls and partitions and structural elements. Do not use wedges.
 - .3 Built masonry to tie in with stabilizers, with provision for vertical movement.
- .8 Loose steel lintels:
 - .1 Install loose steel lintels. Centre over opening width.
- .9 Control joints:
 - .1 Construct continuous control joints as indicated.

- .10 Movement joints:
 - .1 Build-in continuous movement joints as indicated.
- .11 Interface with other work:
 - .1 Cut openings in existing work as indicated.
 - .2 Openings in walls: reviewed by Consultant.
 - .3 Make good existing work. Use materials to match existing.
- .12 Weep Holes:
 - .1 Provide partial head joints spaced every 600mm c/c.
 - .2 Weep hole vents as per 04 05 23 - Masonry Accessories

3.7 SITE TOLERANCES

- .1 Tolerances in notes to CSA-A371 apply.

3.8 FIELD QUALITY CONTROL

- .1 Site Tests, Inspection:
 - .1 Perform field inspection and testing in accordance with Section 01 45 00 - Quality Control.
 - .2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.
- .2 Manufacturer's Services:
 - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, and protection of its products, and submit written reports in acceptable format to verify compliance of work with Contract.
 - .2 Manufacturer's field services: provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.
 - .3 Schedule site visits to review work as installation is about to begin.
 - .4 Schedule site visits to review work at stages listed:
 - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
 - .2 Upon completion of work, after cleaning is carried out.
 - .5 Obtain reports within three days of review and submit immediately to Consultant.

3.9 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Progress Cleaning: in accordance with related masonry sections.
- .3 Final Cleaning:
 - .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
 - .2 Upon completion of installation and verification of performance of installation, remove surplus materials, rubbish, tools and equipment barriers.
- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Divert unused or damaged masonry units and glass block from landfill as specified in Section 01 74 19 - Waste Management and Disposal.

3.10 PROTECTION

- .1 Temporary Bracing:
 - .1 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.
 - .2 Bracing approved by Consultant.
 - .3 Brace masonry walls as necessary to resist wind pressure and lateral forces during construction.
- .2 Moisture Protection:
 - .1 Keep masonry dry using waterproof, nonstaining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until completed and protected by flashing or other permanent construction.
 - .2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.
 - .3 Air Temperature Protection: protect completed masonry as recommended in (IMIAC) Recommended Practices & Guide Specification for Hot & Cold Weather Masonry Construction.

END OF SECTION

PART 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CAN/CSA A179-04, Mortar and Grout for Unit Masonry.
 - .3 CAN/CSA A371-04, Masonry Construction for Buildings.
 - .4 CAN/CSA-A3000-03, Cementitious Materials Compendium; CAN/CSA-A3002-03, Masonry and Mortar Cement

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Provide manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.
- .2 Samples:
 - .1 Samples: provide unit samples in accordance with Section 04 05 00 - Common Work Results for Masonry, supplemented as follows:
 - .1 Provide two samples of available coloured mortar.
 - .2 Provide confirmation of source or product data sheet, prior to mixing or preparation of mortars, to Consultant of:
 - .1 Aggregate sand.
 - .2 Cement.
 - .3 Lime.
 - .4 Colour pigment samples.
- .3 Manufacturer's Instructions:
 - .1 Provide manufacturer's installation instructions.

1.3 QUALITY ASSURANCE

- .1 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
- .2 Mock-ups:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry supplemented as follows:
 - .1 Construct mock-up sample panel of pointing.
 - .2 Sample panel: 3000 mm x 3000 mm using proposed procedures, colours, texture, finish and workmanship.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handles masonry mortar and grout materials in accordance with Section 01 33 00 submittal procedure, supplemented as follows:
 - .1 Deliver prepackaged, dry-blended mortar mix to project site in labelled plastic-lined bags each bearing name and address of manufacturer, production codes or batch numbers, and colour or formula numbers.
 - .2 Maintain mortar, grout and packaged materials clean, dry, and protected against dampness, freezing, traffic and contamination by foreign materials.

1.5 SITE CONDITIONS

- .1 Ambient Conditions: maintain materials and surrounding air temperature to:
 - .1 Minimum 10 degrees C prior to, during, and 48 hours after completion of masonry work.
 - .2 Maximum 32 degrees C prior to, during, and 48 hours after completion of masonry work.
- .2 Weather Requirements: CAN/CSA A371 International Masonry Industry All-Weather Council (IMIAC) - Recommended Practices and Guide Specifications for Hot and Cold Weather Masonry Construction.

PART 2 Product

2.1 MATERIALS

- .1 Use same brands of materials and source of aggregate for entire project.
- .2 Cement:
 - .1 Portland Cement: to CAN/CSA-A3000,MS - Moderate sulphate-resistant hydraulic cement (Type 20)
 - .1 Use low VOC products in compliance with SCAQMD Rule 1168.
 - .2 Masonry Cement: to CAN/CSA-A3002 and CAN/CSA A179, Type N.
 - .3 Mortar Cement: to CAN/CSA-A3002 and CAN/CSA A179, Type N.
 - .1 Use low VOC products in compliance with SCAQMD Rule 1168.
 - .4 Packaged Dry Combined Materials for mortar: to CAN/CSA A179, Type N, using white colour cement.
- .3 Aggregate: supplied by one supplier.
 - .1 Fine Aggregate: to CAN/CSA A179, natural sand.
- .4 Water: clean and potable.
- .5 Lime:
 - .1 Hydrated Lime: to CAN/CSA A179, Type S.
- .6 Bonding Agent: latex type.
- .7 Polymer Latex: organic polymer latex admixture of butadiene-styrene type non-emulsifiable bonding admixture.

2.2 COLOUR ADDITIVES

- .1 Use colouring admixture not exceeding 10% of cement content by mass, or integrally coloured masonry cement, to produce coloured mortar to match approved sample. Admixtures to be approved prior to use. Use in accordance with the specific manufacturer's recommendations.
- .2 White mortar: use white Portland cement, and lime to produce mortar type specified.
- .3 Powder: inorganic mineral oxide pigment; colour as selected by consultant.

2.3 ADMIXTURES

- .1 Water Repellent Agents: liquid.
 - .1 Use low VOC products in compliance with SCAQMD Rule 1168.

2.4 MORTAR MIXES

- .1 Mortar for exterior masonry above grade:
 - .1 Loadbearing: type S based on property specifications.
 - .2 Non-Loadbearing: N based on property specifications.
- .2 Mortar for interior masonry:
 - .1 Loadbearing: type N based on property specifications.
 - .2 Non-Loadbearing: N based on property specifications.
- .3 Pointing Mortar: CAN/CSA A179, Type N using property specification with maximum 2 percent ammonium stearate or calcium stearate per cement weight.
- .4 Parging mortar: type N to CAN/CSA A179.
- .5 Following applies regardless of mortar types and uses specified above:
 - .1 Mortar for calcium silicate brick and concrete brick: type O based on proportion specifications.
 - .2 Mortar for stonework: type N based on property specifications.
 - .3 Mortar for grouted reinforced masonry: type S based on property specifications.
 - .4 Mortar mix to suit manufacturer recommendations for Architectural Concrete Block.

2.5 MORTAR MIXING

- .1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to be within 1% accuracy.
- .2 Mix mortar ingredients in accordance with CAN/CSA A179 in quantities needed for immediate use.
- .3 Maintain sand uniformly damp immediately before mixing process.
- .4 Add mortar colour and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and colouration.
- .5 Do not use anti-freeze compounds including calcium chloride or chloride based compounds.
- .6 Do not add air entraining admixture to mortar mix.
- .7 Use a batch type mixer in accordance with CAN/CSA A179.
- .8 Pointing mortar: prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour no more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.
- .9 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.
- .10 Use mortar within 2 hours after mixing at temperatures of 32 degrees C, or 2-1/2 hours at temperatures under 10 degrees C.

2.6 GROUT MIXES

- .1 Bond Beams: grout mix 20 MPa strength at 28 days; 200 mm slump; premixed type in accordance with CAN/CSA-A23.1.
- .2 Lintels: grout mix 20 MPa strength at 28 days; 200 mm slump; premixed type in accordance with CAN/CSA-A23.1.

- .3 Grout: Minimum compressive strength of 20 MPa at 28 days. Maximum aggregate size and grout slump: CAN/CSA A179.

2.7 GROUT MIXING

- .1 Mix batched and delivered grout in accordance with CAN/CSA-A23.1 transit mixed.
- .2 Mix grout ingredients in quantities needed for immediate use in accordance with CAN/CSA A179 fine grout.
- .3 Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- .4 Do not use calcium chloride or chloride based admixtures.

PART 3 Execution

3.1 EXAMINATION

- .1 Request inspection of spaces to be grouted.

3.2 PREPARATION

- .1 Apply bonding agent to existing concrete surfaces.
- .2 Plug clean-out holes with brick & block masonry units. Brace masonry for wet grout pressure.

3.3 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.4 CONSTRUCTION

- .1 Do masonry mortar and grout work in accordance with CAN/CSA A179 except where specified otherwise.
- .2 Apply parging in uniform coating not less than total 10 mm thick , where indicated.

3.5 MIXING

- .1 All pointing mortar can be mixed using a regular paddle mixer. Only electric motor mixers are permissible. Mixers run on hydrocarbons are not permitted, due to fumes.
- .2 Clean all mixing boards and mechanical mixing machine between batches.
- .3 Mortar must be weaker than the units it is binding.
- .4 Contractor to appoint one individual to mix mortar, for duration of project. In the event that this individual must be changed, mortar mixing must cease until the new individual is trained, and mortar mix is tested.

3.6 MORTAR PLACEMENT

- .1 Install mortar to manufacturer's instructions.

- .2 Install mortar to requirements of CAN/CSA A179.
- .3 Remove excess mortar from grout spaces.
- .4 Use a 'mortar stop' board during installation to prevent accumulation of excess mortar from restricting and/or falling into drainage cavity.

3.7 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.
- .2 Remove droppings and splashings using clean sponge and water.
- .3 Clean masonry with low pressure clean water and soft natural bristle brush.

END OF SECTION

PART 1 General

1.1 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM A 82/A 82M-05a, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - .2 ASTM A 307-04, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - .3 ASTM A 580/A 580M-06, Standard Specification for Stainless Steel Wire.
 - .4 ASTM A 641/A 641M-03, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CAN/CSA A179-04, Mortar and Grout for Unit Masonry.
 - .3 CAN/CSA A370-04, Connectors for Masonry.
 - .4 CAN/CSA A371-04, Masonry Construction for Buildings.
 - .5 CSA-S304.1-04, Design of Masonry Structures.
 - .6 CSA W186-M1990, Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheets illustrating products to be incorporated into project for specified products.
 - .2 Provide two copies of Workplace Hazardous Materials Information System (WHMIS).
- .3 Shop Drawings:
 - .1 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Provide shop drawings detailing bar bending details, anchorage details lists and placing drawings.
 - .3 On placing drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.
- .4 Samples:
 - .1 Provide samples of each masonry anchor type in accordance with Section 01 33 00 - Submittal Procedures.
- .5 Manufacturer's Instructions:
 - .1 Provide manufacturer's installation instructions.

1.3 QUALITY ASSURANCE

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

- .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Section 04 05 00 - Common Work Results for Masonry.
- .4 Mock-ups:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry supplemented as follows:
 - .1 Construct mock-ups panel of anchorage installation reinforcement installation.
 - .2 Sample panel: 3000 mm x 3000 mm using proposed procedures, anchorage material, connectors, reinforcement material, and workmanship.

1.4 FIELD MEASUREMENTS

- .1 Make field measurements necessary to ensure proper fit of members.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle masonry anchorage and reinforcing materials in accordance with Section 01 61 00 - Common Product Requirements, supplemented as follows:
 - .1 Deliver reinforcement and connectors identified in shop and placement drawings.

PART 2 Product

2.1 MATERIALS

- .1 Bar reinforcement: Steel to CAN/CSA G30.18 (latest edition), $F_y=400$ MPa
- .2 Connectors: to CAN/CSA A370 and CSA-S304.1.
- .3 Corrosion protection: to CSA-S304.1, galvanized to CSA-S304.1 and CAN/CSA A370.
- .4 Fasteners: installed post-construction:
 - .1 Screw Shields and Plugs: placed directly into solid masonry units.
 - .2 Bolts and Screws: size and type to suit application, locate where indicated.
 - .3 Nails: case-hardened cut or spiral nails, size and type to suit fastening application.
 - .4 Powder-Driven Fasteners: pin styles and lengths to suit fastening application in accordance with manufacturers use, load and hold recommendations.
 - .5 Adhesives: epoxies, mastics and contact cements for fastening applications, use in accordance with manufacturers' recommendations.
- .5 Brick Ties: hot dip galvanized to CAN/CSA A370.
 - .1 Proprietary L-Bracket Thermally Broken System with the following components:
 - .1 Thermal L-Bracket
 - .2 Masonry V-Tie
 - .3 Insulation Support Stopper
 - .2 Basis of Design: Fero Corporation, Model: Thermal Tie – Holed Rap-Tie Masonry Connector
- .6 Conventional Bolts:
 - .1 Bolts: to ASTM A 36, bar stock shop threaded, bent bar anchors, J shaped.
 - .2 Plate anchors: steel to ASTM A 36, weld square of circular steel plate perpendicular to axis of steel bar threaded on opposite end.
 - .3 Through bolt rods: to ASTM A 307 threaded rod or threaded ASTM A 36 bar stock.

2.2 FABRICATION

- .1 Fabricate reinforcing in accordance with CAN/CSA-A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Fabricate connectors in accordance with CAN/CSA A370.
- .3 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.
- .4 Ship reinforcement and connectors, clearly identified in accordance with drawings.

PART 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PREPARATION

- .1 Direct and coordinate placement of metal anchors for masonry supplied to other Sections.

3.3 INSTALLATION

- .1 Supply and install masonry connectors and reinforcement in accordance with CAN/CSA A370, CAN/CSA A371, CAN/CSA-A23.1 and CSA-S304.1 unless indicated otherwise.
- .2 Supply and install additional reinforcement to masonry as indicated.

3.4 BONDING AND TYING

- .1 Bond walls of two or more wythes using metal connectors in accordance with CSA-S304.1, CAN/CSA A371 and as indicated.
- .2 Tie masonry veneer to backing in accordance with NBC, CSA-S304.1, CAN/CSA A371 and as indicated.
- .3 Install unit, adjustable, single wythe and multiple wythe joint reinforcement where indicated and in accordance with CAN/CSA A370 and CAN/CSA A371.
 - .1 Bond walls of two or more wythes using metal connectors in accordance with CAN/CSA A371 and as indicated.
 - .2 Install horizontal joint reinforcement 400 mm on centre.
 - .3 Place masonry joint reinforcement in first horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
 - .4 Place joint reinforcement continuous in first joint below top of walls.
 - .5 Lap joint reinforcement ends minimum 150 mm.
 - .6 Connect stack bonded unit joint corners and intersections with strap anchors 400 mm on centre.

3.5 GROUTING

- .1 Grout masonry in accordance with CSA-S304.1, CAN/CSA A371 and CAN/CSA A179 and as indicated.

3.6 ANCHORS

- .1 Supply and install metal anchors in accordance with CAN/CSA A370 and CAN/CSA A371 as indicated.

3.7 LATERAL SUPPORT AND ANCHORAGE

- .1 Supply and install lateral support and anchorage in accordance with CSA-S304.1 and as indicated.

3.8 MOVEMENT JOINTS

- .1 Reinforcement will not be continuous across movement joints unless otherwise indicated.

3.9 FIELD BENDING

- .1 Do not field bend reinforcement and connectors except where indicated or authorized by Consultant.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars and connectors which develop cracks or splits.

3.10 FIELD TOUCH-UP

- .1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.

3.11 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A165 Series, CSA Standards on Concrete Masonry Units covers: A165.1, A165.2, A165.3.
 - .2 CAN/CSA A371-04, Masonry Construction for Buildings.
 - .3 CSA S304.1-04, Design of Masonry Structures.
- .2 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S101-07, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Product Data: provide product data, including manufacturer's printed data sheets and catalogue pages illustrating products to be incorporated into project for specified products.
- .3 Samples:
 - .1 Provide unit samples in accordance with Section 04 05 00 - Common Work Results for Masonry.
- .4 Mock-up:
 - .1 Construct mock-up in accordance with Section 01 45 00 Quality Control.
 - .2 Construct typical exterior wall 1200 mm wide x full wall height, incorporating connection to curtain wall, insulation, and junction with roof system; illustrating materials interface and seals.
 - .3 Locate where directed.
 - .4 Mock-up may remain as part of finished work.
 - .5 Allow 24 hours for inspection of mock-up by consultant before proceeding with air barrier work.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle concrete unit masonry in accordance with Section 04 05 00 - Common Work Results for Masonry.
- .2 Packaging Waste Management:
 - .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Standard concrete block units Type 1: to CAN/CSA-A165 Series (CAN/CSA-A165.1).
 - .1 Classification: H/20/A/O.
 - .2 Dimensions Nominal: 200 mm wide x 200 mm high x 400 mm long.
 - .3 Special shapes: provide bull-nosed or double bull-nosed units for exposed corners. Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated.
- .2 Standard concrete block units Type 2: to CAN/CSA-A165 Series (CAN/CSA-A165.1).
 - .1 Classification: S75/20/A/O.
 - .2 Dimensions Nominal: 200 mm wide x 200 mm high x 400 mm long.
 - .3 Special shapes: provide bull-nosed or double bull-nosed units for exposed corners. Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated.
- .3 Standard concrete block units Type 3: to CAN/CSA-A165 Series (CAN/CSA-A165.1).
 - .1 Classification: H/20/A/O.
 - .2 Dimensions Nominal: 250 mm wide x 200 mm high x 400 mm long.
 - .3 Special shapes: provide bull-nosed or double bull-nosed units for exposed corners. Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated.

2.2 REINFORCEMENT

- .1 Reinforcement in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

2.3 CONNECTORS

- .1 Connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

2.4 FLASHING

- .1 Flashing: in accordance with Section 04 05 23 - Masonry Accessories.

2.5 MORTAR MIXES

- .1 Mortar and mortar mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.
- .2 Follow manufacturer's recommendations for compatibility with proprietary masonry products as Architectural Concrete Block.

2.6 GROUT MIXES

- .1 Grout and grout mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.

2.7 CLEANING COMPOUNDS

- .1 Compatible with substrate and acceptable to masonry manufacturer for use on products.
- .2 Cleaning compounds compatible with concrete unit masonry and in accordance with manufacturer's written recommendations and instructions.

2.8 TOLERANCES

- .1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA A165.1, supplemented as follows:
 - .1 Maximum variation between units within specific job lot not to exceed 2 mm.
 - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
 - .3 Out of square tolerance not to exceed 2 mm.
- .2 Tolerances for architectural concrete masonry units in accordance with CAN/CSA A165.1, supplemented as follows:
 - .1 Maximum variation in length or height between units within specific job lot for specified dimension not to exceed 2 mm.
 - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
 - .3 Out of square tolerance not to exceed 2 mm.
 - .4 Maximum variation in width between units within specific job lot for specified dimension not to exceed 2 mm.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verify surfaces and conditions are ready to accept work of this Section.
- .2 Commencing installation means acceptance of substrates.

3.2 PREPARATION

- .1 Protect adjacent finished materials from damage due to masonry work.

3.3 INSTALLATION

- .1 Architectural concrete unit masonry:
 - .1 Bond: running.
 - .2 Coursing height: 200 mm for one block and one joint.
 - .3 Jointing: raked where exposed or where paint or finish coating is specified.

3.4 REINFORCEMENT

- .1 Install reinforcing in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing .

3.5 CONNECTORS

- .1 Install connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing .

3.6 FLASHING

- .1 Install flashings: in accordance with Section 04 05 23 - Masonry Accessories.

3.7 MORTAR PLACEMENT

- .1 Place mortar in accordance with Section 04 05 12 - Masonry Mortar and Grout.

3.8 GROUT PLACEMENT

- .1 Place grout in accordance with Section 04 05 12 - Masonry Mortar and Grout.

3.9 CONSTRUCTION

- .1 Cull out masonry units, in accordance with CAN/CSA A165 and approved range of colour samples, with chips, cracks, broken corners, excessive colour and texture variation.
- .2 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors, inserts, sleeves and conduits.
- .3 Construct masonry walls using running bond as indicated.
- .4 Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.
- .5 Fit masonry closely against electrical and plumbing outlets so collars, plates and covers overlap and conceal cuts.
- .6 Install movement joints and keep free of mortar where indicated.
- .7 Hollow Units: spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar.
- .8 Solid Units: apply mortar over entire vertical and horizontal surfaces. Avoid bridging of airspace between brick veneer and backup wall with mortar.
- .9 Ensure compacted head joints. Use full or face-shell joint as indicated.
- .10 Tamp units firmly into place.
- .11 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.
- .12 Tool exposed joints concave weathered/raked for interior work; strike concealed joints flush.
- .13 After mortar has achieved initial set up, tool joints.
- .14 Do not interrupt bond below or above openings.
- .15 Weep Holes:
 - .1 Provide partial head joints spaced every 600mm c/c.
 - .2 Weep hole vents as per 04 05 23 - Masonry Accessories

3.10 REPAIR/RESTORATION

- .1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

3.11 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning, supplemented as follows.
 - .1 Progress Cleaning:
 - .1 Standard Concrete Unit Masonry:
 - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with

- suitable brush or burlap.
- .2 Architectural Concrete Unit Masonry:
 - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
- .3 Prefaced Concrete Unit Masonry:
 - .1 Clean masonry as work progresses using soft, clean cloths, within few minutes after laying. Upon completion, when mortar has set so that it will not be damaged by cleaning, clean with soft sponge or clean cloths, brush, and clean water. Polish with soft, clean cloths.

3.12 PROTECTION

- .1 Brace and protect concrete unit masonry in accordance with Section 04 05 00 - Common Work Results for Masonry.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Angle lintels
 - .2 Pipe railings
 - .3 Access ladders
 - .4 Bollards
 - .5 Miscellaneous metal fabrications
- .2 Products supplied but not installed under this section:
 - .1 Deliver items for casting into concrete and incorporating into masonry together with setting templates to appropriate location and construction personnel.

1.2 RELATED REQUIREMENTS

- .1 Section 03 30 00 – Cast-in-Place Concrete
- .2 Section 04 22 00 – Concrete Unit Masonry
- .3 Section 07 92 00 – Joint Sealants
- .4 Section 09 91 13 - Exterior Painting
- .5 Section 09 91 23 - Interior Painting

1.3 DEFINITIONS

- .1 Application Specialist: Individual who performs surface preparation and application of protective coatings and linings to steel surfaces of complex industrial structures.

1.4 REFERENCE STANDARDS

- .1 Aluminum Association (AA):
 - .1 AA DAF-45-2003, Designation System for Aluminum Finishes
- .2 Association for Materials Protection and Performance (AMPP):
 - .1 ANSI/NACE No. 13/SSPC-ACS-1-2016, Industrial Coating and Lining Application Specialist Qualification and Certification
- .3 ASTM International (ASTM):
 - .1 ASTM A53/A53M-22, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - .2 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .3 ASTM A153/A153M-16a, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - .4 ASTM A240/A240M-23, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - .5 ASTM A307-21, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
 - .6 ASTM A480/A480M-23, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

- .7 ASTM A554-21, Standard Specification for Welded Stainless Steel Mechanical Tubing
- .8 ASTM B209/B209M-21a, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- .9 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants
- .4 Canadian Environmental Protection Act (CEPA):
 - .1 SOR/2009-264, Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations
- .5 CSA Group (CSA):
 - .1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
 - .2 CSA G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles
 - .3 CSA S16:19, Design of Steel Structures
 - .4 CSA W48:23, Filler Metals and Allied Materials for Metal Arc Welding
 - .5 CSA W59-18, Welded Steel Construction (Metal Arc Welding)
- .6 The Master Painters Institute (MPI):
 - .1 Architectural Painting Specification Manual (ASM), current edition
 - .2 Approved Products List (APL), current edition
- .7 South Coast Air Quality Management District (SCAQMD):
 - .1 SCAQMD Rule 1113-16, Architectural Coatings
 - .2 SCAQMD Rule 1168-22, Adhesive and Sealant Applications

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with Section 03 30 00 – Cast-in-Place Concrete for casting anchors, trench drains, bollards into concrete.
 - .1 Provide concrete Subcontractors with copies of reviewed shop drawings and setting templates.
 - .2 Coordinate with Section 04 22 00 – Concrete Unit Masonry for incorporating anchors into masonry.
 - .1 Provide masonry Subcontractors with copies of reviewed shop drawings and setting templates.
 - .3 Coordinate with Section 09 91 13 - Exterior Painting for site finishing items installed outside.
 - .4 Coordinate with Section 09 91 23 - Interior Painting for site finishing items installed inside.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit the following action submittals before starting work of this section:
 - .1 Product Data: Product literature and data sheets for installed products, including product characteristics, performance criteria, physical sizes, finishes, and limitations.
 - .1 WHMIS SDS for site-applied primers, coatings, paints, and other finishes.
 - .2 Shop Drawings:
 - .1 Sealed and signed by a qualified professional in accordance with Section 01 43 00 – Quality Assurance.
 - .2 Indicate materials, base metal thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
- .3 Submit the following informational submittals as work progresses:
 - .1 Certificates: Signed by the manufacturer certifying materials comply with specified performance characteristics and physical properties.

- .2 Sustainable Design Submittals: Information demonstrating sustainability characteristics specified in this section.
 - .1 Recycled Content: Submit listing of recycled content products used, including details of required percentages of recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for the Project.
 - .2 Regional Materials: Submit evidence that the Project incorporates required percentage of regional materials and products, showing their cost, distance from the Project to furthest site of extraction or manufacture, and total cost of materials for the Project.
 - .3 Low-Emitting Materials: Submit listing of [paints and coatings] used in building showing their compliance with VOC and chemical component limits or restrictions requirements.
- .4 Certificates:
 - .1 Qualification Statements for Application Specialists: In accordance with ANSI/NACE No. 13/SSPC-ASC-1.

1.7 QUALITY ASSURANCE

- .1 Application Specialist Qualifications:
 - .1 Industrial coating applicators who perform steel surfaces preparation and coating applications to be certified by a recognized applicator certification agency, in accordance with ANSI/NACE No.13/SSPC-ACS-1, Applicator Certification Standard (ACS).
- .2 Application Specialists to maintain current and valid ACS certification for the duration of the applicable work of this section.
 - .1 Application Specialists who perform surface preparation and coating application work on this Project must have a current ACS.
- .3 Notify the Consultant of any change in Application Specialist certification status.
 - .1 Delays to the completion of the Project due to invalid certifications will not be considered, and liquidated damage clause will not be waived due to non-performance by the Contractor.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Steel Sections and Plates: To CSA G40.20/G40.21, Grade 300W.
- .2 Steel Pipe: To ASTM A53/A53M, standard weight.
- .3 Steel Shapes: To CSA G40.20/G40.21, Grade 350W.
- .4 Steel Tubes: To CSA G40.20/G40.21, Grade 350W.
- .5 Welding Materials: To CSA W59.
- .6 Welding Electrodes: To CSA W48 Series.
- .7 Bolts and Anchor Bolts: To ASTM A307, galvanized to ASTM A153/A153M.
- .8 Aluminum Sheet: To ASTM B209/B209M.
- .9 Stainless Steel Tubing: To ASTM A554, Grade MT-302, seamless welded.
- .10 Stainless Steel Sheet: To ASTM A240/A240M, Type 304.

- .11 Proprietary metal framing system: Provide a complete metal framing system, compete with perforated steel framing members, compatible connectors, fasteners and other accessories as required.
Standard of acceptance: Subject to compliance with requirements, provide products by one of the following:
 - .1 Allied Tube & Conduit.
 - .2 Cooper B-Line, Inc.
 - .3 Flex-Strut Inc.
 - .4 GS Metals Corp.
 - .5 Thomas & Betts Corporation.
 - .6 Unistrut Corporation; Tyco International, Ltd.
 - .7 Wesanco, Inc.
- .12 Grout: Non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

2.2 FABRICATION

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Use self-tapping, shake-proof round-headed screws on items requiring assembly by screws or as indicated.
- .3 Where possible, fit and shop-assemble work, ready for erection.
- .4 Make exposed welds continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 ANGLE LINTEL FABRICATION

- .1 Steel Angles: Galvanized, sizes indicated for openings. Provide minimum 150 mm bearing at ends.
- .2 Weld or bolt back-to-back angles to profiles as indicated in Contract Documents.
- .3 Finish for Interior Angle Lintels: Shop coat primer.
 - .1 Colour: To be selected by the Consultant from the manufacturer's standard range.

2.4 TUBE RAILING FABRICATION

- .1 Steel Tube: 40 mm nominal outside diameter, formed to shapes and sizes as indicated.
- .2 Galvanize exterior pipe railings after fabrication. Shop coat prime interior railings after fabrication.
- .3 Finish for Interior Tube Railings: Shop coat primer.
 - .1 Colour: To be selected by the Consultant from the manufacturer's standard range.

2.5 ACCESS LADDER FABRICATION

- .1 Stringers: 10 mm x 65 mm x 4 mm thick, steel.
- .2 Steel Rungs: 20 mm diameter, welded to stringers at 300 mm on-centre.
- .3 Brackets: Sizes and shapes as indicated, weld to stringers at 3000 mm on-centre, complete with fixing anchors.
- .4 Finish for Interior Access Ladders: Shop painted.
 - .1 Colour: To be selected by the Consultant from the manufacturer's standard range.

2.6 BOLLARD FABRICATION

- .1 Fabricate bollards to sizes indicated from Schedule 40 steel pipe.
 - .1 Length: extend below grade to below the frost line and 1220 mm above finished floor].
- .2 Galvanize bollards.

2.7 MISCELLANEOUS FABRICATIONS

- .1 Miscellaneous Framing and Supports: Provide steel framing and supports for applications indicated that are not part of structural steel framework, as required to complete the Work.
- .2 Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitred joints for site connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.

2.8 FINISHES

- .1 Sustainability Characteristics:
 - .1 VOC and other chemical content restrictions for paints and coatings: To SOR/2009-264[or SCAQMD Rule 1113, whichever is more stringent].
- .2 Primer Materials:
 - .1 For interior steel surfaces: MPI APL #76 or #79, at the option of the fabricator.
 - .2 For exterior steel surfaces: MPI APL #79.
 - .3 Touch-up primer for galvanized surfaces: Zinc-rich primer, APL #19
- .3 Shop Finishing Methods:
 - .1 Galvanizing: To CSA G164, ASTM A123/A123M, hot-dip galvanizing with 600 g/m² zinc coating.
 - .2 Stainless-steel tubing: Match No. 4 finish in accordance with ASTM A480/A480M.
 - .3 Stainless steel sheet: To ASTM A480/A480M, No. 4 finish.
 - .4 Aluminum: To AA DAF-45.
 - .1 Colour: To be selected by the Consultant from the manufacturer's standard range.
 - .5 Shop painting: In accordance with MPI ASM.
 - .1 Apply one shop coat of primer to metal items, with the exception of galvanized or concrete encased items.
 - .2 Use unadulterated primer as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, and grease when temperature is a minimum 7°C.
 - .3 Clean surfaces to be site welded; do not paint.
 - .4 Leave surfaces to be welded and surfaces receiving sprayed fireproofing unpainted and unprimed.
 - .5 Leave surfaces to be embedded in concrete unpainted.
 - .6 Apply two coats of primer to parts inaccessible after final assembly.

2.9 ISOLATION COATING

- .1 Isolate aluminum from the following components by using bituminous paint:
 - .1 dissimilar metals, except small areas of stainless steel, zinc, or white bronze
 - .2 concrete, mortar and masonry
 - .3 wood

2.10 ACCESSORIES

- .1 Protective Film: Treated paper or clear plastic, self-adhering release type as recommended by architectural metal fabricator to protect finished metals. Film to be easily removable without damaging finished surfaces.
- .2 Silicone Sealant: To ASTM C920, Type S, Grade NS, Class 50, Use NT and G.
 - .1 VOC and other chemical content restrictions: To SCAQMD Rule 1168.
- .3 Adhesives: High-pressure bonding type, suitable for materials being bonded. Contact adhesives not acceptable.
 - .1 VOC and other chemical content restrictions: To SCAQMD Rule 1168.

2.11 MISCELLANEOUS METAL WORK

- .1 Examine architectural, structural, mechanical and electrical drawings and specifications and furnish all miscellaneous metalwork items required for proper execution of project, including, but not necessarily limited to, the items described herein.
- .2 Supply for installation by respective trades, steel brackets, supports and angles as indicated. Drill for countersunk screws and anchor bolts. Generally, prime paint for interior installation, galvanize where indicated. Include miscellaneous steel fabrication for incorporation into casework. Coordinate with Section 06 40 00 "Architectural Woodwork and Caseworkl."
- .3 Provide all accessories necessary for proper installation and correlation with adjoining work.

2.12 MISCELLANEOUS FRAMING AND SUPPORTS

- .1 General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- .2 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.
 - .1 Fabricate units from slotted channel framing where indicated.
 - .2 Furnish inserts for units installed after concrete is placed.
- .3 Galvanize exterior miscellaneous framing and supports where indicated.
- .4 Shop-prime interior miscellaneous framing and supports for paint finish by Section 09 91 23 "Painting".

2.13 EQUIPMENT RACKS

- .1 Coordinate with the applicable other trades and provide racks to support electrical and other equipment as required.
- .2 Fabricate racks using the specified proprietary metal framing system.
- .3 Member sizes and type of connectors to be selected by the structural engineer responsible for the shop drawings to carry in-service loads

2.14 CEILING EQUIPMENT SUPPORT SYSTEM

- .1 Construct a shop-fabricated or field-fabricated pipe-support assembly for supporting multiple parallel pipes, using specified proprietary metal framing system and meeting specified design requirements.
 - .1 Locate the support members shall be located as indicated on the drawings at the spacing shown. The spacing shall be as shown on the drawings

- .2 Design and construct to MFMA-4.
- .3 Channels: Continuous slotted steel channel with inturred lips.
- .4 Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

2.15 OVERHEAD DOOR MOUNTING PLATES

- .1 Fabricate Overhead Door Mounting Plates as indicated and as follows:
 - .1 Material: Steel
 - .2 Thickness: Min. 12.7mm
 - .3 Size: Coordinate size with Overhead Door Manufacturer.
 - .4 Location: Coordinate final location with Overhead Door Manufacturer.
 - .5 Mounting: Plates are to be welded to Overhead Door HSS Beam.
 - .6 Quantity: anticipate 6 plates per door coordinate with Overhead Door Manufacturer.

2.16 COORDINATION

- .1 Coordinate the work of this Section with the structural steelwork supplier to ensure that all structural steelwork and metal fabrications required for a complete project are included.
- .2 Be advised that claims for extras to the Contract Sum for the supply and/or installation of structural steelwork or metal fabrications arising from failure to coordinate the work of this Section with the structural steelwork supplier will not be considered.
- .3 Where the work of this Section is furnished for installation by other Sections, coordinate with the appropriate Sections to ensure a proper fit and to schedule delivery dates to ensure the expeditious completion of the project.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Thoroughly clean and suitably pre-treat steel prior to finishing.
- .2 Remove loose mill scale, rust, oil, grease, dirt, and other foreign matter using one or more of the following methods:
 - .1 solvent cleaning
 - .2 wire brushing
 - .3 power wire brushing
 - .4 abrasive blasting
- .3 Grind sharp projections until smooth.
- .4 Prepare metal surfaces to receive paint finishes in accordance with MPI ASM.

3.2 INSTALLATION – GENERAL

- .1 Install metal fabrications as indicated on Drawings.
- .2 Install in accordance with reviewed shop drawings, square, plumb, straight, true, accurately fitted, and with tight joints and intersections.
- .3 Perform welding in accordance with CSA W59 unless specified otherwise.
- .4 Provide suitable anchorage such as dowels, anchor clips, bar anchors, expansion bolts and shields,

and toggles acceptable to the Consultant.

- .5 Provide exposed fastening devices to match finish and be compatible with material through which they pass.
- .6 Make site connections [with fasteners to CSA S16 or site-welded connections.
- .7 Touch up rivets, site welds, bolts, and burnt or scratched surfaces with primer after installation.
 - .1 Primer: In accordance with FINISHES in this section.
- .8 Touch up galvanized surfaces burned by site welding with zinc-rich primer after installation.
 - .1 Zinc-rich primer: In accordance with FINISHES in this section.

3.3 TUBE RAILING INSTALLATION

- .1 Install pipe railings as indicated.
- .2 Set railing posts in concrete. Grout to fill hole. Trowel surface smooth and flush with adjacent surfaces.

3.4 ACCESS LADDER INSTALLATION

- .1 Install access ladders in locations as indicated.
- .2 Erect ladders 150 mm clear of wall on bracket supports.

3.5 BOLLARD INSTALLATION

- .1 Install bollards as indicated on Drawings.
- .2 Fill with concrete in accordance with Section 03 30 00 – Cast-in-Place Concrete. Form smooth, rounded top.
- .3 Paint bollards on site.
 - .1 Colour: Safety yellow.

3.6 METALWORK INTEGRATE INTO THE WORK OF OTHER SECTIONS

- .1 Coordinate with the appropriate other Sections, work which is to be integrated into the work of those Sections.
- .2 Where appropriate, fabricate the work of this Section and hand over to others for installation.
- .3 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .4 Hand items over for incorporating into casework to casework fabricator.

3.7 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- .1 General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- .2 Hand over the concrete isolation pad edging to Section 06 10 00 "Rough Carpentry" for attachment to the plywood base.

3.8 EQUIPMENT RACKS

- .1 Coordinate with the applicable other trades and install equipment racks as required and as indicated on the reviewed and accepted shop drawings.
- .2 Install the rack system in accordance with the manufacturer's printed instructions.

3.9 ADJUSTING AND CLEANING

- .1 Touch-up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA1 for touching up shop-painted surfaces.
 - .1 Apply by brush or spray to provide a minimum 0.05-mm dry film thickness.
- .2 Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.
- .3 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.
- .5 Make good any damage caused by the work of this Section.

END OF SECTION

PART 1 GENERAL

1.1 DEFINITIONS

- .1 Application Specialist: An individual who performs surface preparation and application of protective coatings and linings to steel and concrete surfaces of complex industrial structures.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/National Association of Architectural Metal Manufacturers (ANSI/NAAMM)
 - .1 ANSI/NAAMM MBG 531-15, Metal Bar Grating Manual.
- .2 ASTM International (ASTM)
 - .1 ASTM A 53/A5 3M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A 307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM F3125/F3125M-15A, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
- .3 CSA Group (CSA)
 - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
- .4 Green Seal Environmental Standards (GS)
 - .1 GS-11-2011, 3rd Edition, Paints and Coatings.
- .5 National Association of Architectural Metal Manufactures (NAAMM)
 - .1 AMP 510-92, Metal Stair Manual.
- .6 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual-current edition.
- .7 The Society for Protective Coatings (SSPC)
 - .1 Systems and Specifications Manual, Volume 2, 2014 Edition
- .8 Environmental Choice Program
 - .1 CCD-048-95 (R2006), Surface Coatings - Recycled Water-borne
- .9 Underwriters Laboratories (UL)
 - .1 UL 2768-11, Architectural Surface Coatings

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for stairs, ladders and include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Submit two copies of WHMIS SDS in accordance with Section 01 35 29 - Health, Safety, and Emergency Response Procedures.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate construction details, sizes of steel sections and thickness of steel sheet.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating 75% of construction wastes recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence project incorporates required percentage 10% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
 - .4 Low-Emitting Materials:
 - .1 Submit listing of [adhesives and sealants] [and] [paints and coatings] used in building, showing compliance with VOC and chemical component limits or restrictions requirements.

1.4 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Qualifications:
 - .1 Maintain a current and valid ACS certification during project period.
 - .1 Application specialists who perform surface preparation and coating application work on this project must have a current ACS.
 - .2 Notify Consultant of any change in application specialist certification status.
 - .1 Any delays to the completion of the Project due to invalid certifications will not be considered, and liquidated damages shall not be waived for any non-performance by Contractor.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect stairs and ladders from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan, related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Design Requirements:
- .2 Design metal stair, balustrade and landing construction and connections to Ontario Building Code (OBC) vertical and horizontal live load requirements.
- .3 Detail and fabricate stairs to NAAMM Metal Stairs Manual.

2.2 MATERIALS

- .1 Steel sections: to CSA G40.20/G40.21 Grade 300 W.
- .2 Steel plate: to CSA G40.20/G40.21, Grade 260 W.
- .3 Floor plate: to CSA G40.20/G40.21, Grade 260 W.
- .4 Steel pipe: to ASTM A53/A53M, standard weight, schedule 40 seamless black
- .5 Steel tubing: to CSA G40.20/G40.21, Grade 350W, round, sizes and dimensions as indicated.
- .6 Metal bar grating: to ANSI/NAAMM MBG 531, steel, Type W-19-4, with checkered plate nosings.
- .7 Welding materials: to CSA W59.
- .8 Bolts: to ASTM A307
- .9 High strength bolts: to ASTM A F3125/F3125M

2.3 FABRICATION

- .1 Fabricate in accordance with NAAMM, Metal Stair Manual
- .2 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.
- .3 Accurately form connections with exposed faces flush:
 - .1 Make mitres and joints tight.
 - .2 Make risers of equal height.
 - .3 Grind or file exposed welds and steel sections smooth.
 - .4 Shop fabricate stairs in sections as large and complete as practicable.

2.4 PLATE/GRATING STAIRS

- .1 Form steel grating treads and landings from metal bar grating to profile indicated and secure to stringers and supports as indicated. Form landings of steel grating and reinforce as required.
- .2 Form stringers from MC 310 x 15.8.

2.5 PIPE/TUBING BALUSTRADES

- .1 Construct balusters and handrails from steel tubing.
- .2 Cap and weld exposed ends of balusters and handrails.
- .3 Terminate at abutting wall with end flange.

2.6 BAR BALUSTRADES

- .1 Construct bar balustrades as follows:
 - .1 Balusters: 25 x 25 mm bar.
 - .2 Top rail: 30 x 10 mm bar.
 - .3 Bottom rail: 25 x 10 mm bar.
 - .4 Pickets: 12 x 12 mm bar at 100 mm on centre.
- .2 Weld balustrades to stringers as indicated.

2.7 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to [CAN/CSA-G164].

2.8 SHOP PAINTING

- .1 Clean surfaces in accordance with Steel Structures Painting Council Manual Volume 2.
- .2 Apply one coat of shop primer except interior surfaces of pans.
- .3 Apply two coats of primer of different colours to parts inaccessible after final assembly.
- .4 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, grease. Minimum temperature for painting 7 degrees C.
- .5 Do not paint surfaces to be field welded.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for metal stairs and ladders installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION OF STAIRS

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

3.3 CLEANING

- .1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .2 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .4 Clean and wax plastic handrails immediately prior to [building hand over] [final inspection].
- .5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .6 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by metal stairs and ladders installation.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 07 84 00 – Fire Stopping
- .2 Section 09 65 16 - Resilient Sheet Flooring
- .3 Section 09 65 19 - Resilient Tile Flooring
- .4 Section 09 68 13 - Tile Carpeting
- .5 Section 26 05 00 - Common Work Results for Electrical
- .6 Section 27 05 28 – Pathways for Communications Systems
- .7 Section 27 10 05 - Structured Cabling for Communications Systems

1.2 DEFINITIONS

- .1 Environmental Product Declaration (EPD): Third-party verified documentation with supporting Product Category Rule (PCR) and life-cycle assessment (LCA) information, including at least a cradle-to-gate scope. Prepared in accordance with ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
- .2 Industry-wide (generic) EPD with third-party certification (Type III), including external verification where the manufacturer is explicitly recognized as the participant by the program operator.
- .3 Product-specific Type III EPD Products with third-party certification (Type III), including external verification where the manufacturer is explicitly recognized as the participant by the program operator.

1.3 REFERENCE STANDARDS

- .1 The American Society of Mechanical Engineers (ASME):
 - .1 ASME B18.6.1-1981, Wood Screws (Inch Series)
- .2 American National Standards Institute/Telecommunication Industry Association (ANSI/TIA):
 - .1 ANSI/TIA/EIA 569 B-2004, Commercial Building Standard for Telecommunications Pathways and Spaces
- .3 ASTM International (ASTM):
 - .1 ASTM A307-21 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
 - .2 ASTM C954-11, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
 - .3 ASTM D7612-10, Standard Practice for Categorizing Wood and Wood-Based Products According to their Fiber Sources
 - .4 ASTM F1482-21, Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
 - .5 ASTM F1667-13 Standard Specification for Driven Fasteners: Nails, Spikes and Staples
- .4 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems

- .5 CSA Group (CSA):
 - .1 CSA O86-14 Engineered Design in Wood
 - .2 CSA O112.9-10, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure)
 - .3 CSA O121-08, Douglas Fir Plywood
 - .4 CSA O141-05, Softwood Lumber
 - .5 CSA O151-09, Canadian Softwood Plywood
 - .6 CSA O153-13, Poplar Plywood
 - .7 CSA O325-07, Construction Sheathing
 - .8 CSA-O437 Series-93, Standards on OSB and Waferboard
 - .9 CSA O452 Series-94, Design Rated OSB
 - .10 CAN/CSA-Z809-16, Sustainable Forest Management
- .6 Canadian Wood Council:
 - .1 Wood Design Manual 2010 edition
 - .2 Engineering Guide for Wood Frame Construction 2014
- .7 National Lumber Grades Authority (NLGA):
 - .1 Standard Grading Rules for Canadian Lumber 2017
 - .2 NLGA SPS-1-2013, Finger joined Structural Lumber
 - .3 NLGA SPS-2-2013, Machine Graded Lumber
 - .4 NLGA SPS-4-2020, Finger joined Machine Graded Lumber
- .8 ULC Standards/UL Canada (ULC):
 - .1 CAN/ULC-S101-14, Standard Methods for Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Action Submittals (to be submitted before starting any work of this Section):
 - .1 Product Data:
 - .1 Submit manufacturer's instructions, product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit certified test reports for prefabricated structural members from an approved independent laboratory indicating compliance with specifications for specified performance characteristics and physical properties.
 - .3 Submit manufacturer's installation instructions.
- .3 Informational Submittals (to be submitted during the course of Work):
 - .1 Material Certificates: Submit certificates for machine-graded [and fingerjoined] dimensional lumber indicating species and grade selected for each use and design values approved by the NLGA.
- .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.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Protect materials from weather conditions while in transit and while on the jobsite

- .2 Storage and Handling Requirements:
 - .1 Store materials using pallets or blocking a minimum of 150 mm from the ground and covered with protective waterproof sheets allowing for air circulation and ventilation under the covering.
 - .2 Protect edges and corners of sheet materials from damage during handling and storage.
 - .3 Protect kiln-dried and seasoned wood materials from conditions that will cause an increase to moisture content.
 - .4 Stack, lift, brace, cut and notch engineered lumber products in accordance with manufacturer's instructions and recommendations.
 - .5 Store separated reusable wood waste convenient to cutting station and work areas.
- .3 Packaging Waste Management: Perform In accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 DESCRIPTION

- .1 Regulatory Requirements:
 - .1 Lumber Grades: Provide lumber products that are all sides finished (S4S) in nominal dimensions required for the project; grade-marked by accredited agencies of the Canadian Lumber Standards Accreditation Board and that conform to National Grading Rules published by the NLGA.
 - .1 Grading: Machine Grading, Visual Grading, or Both
 - .2 Moisture Content: Kiln Dry, 19% or less
 - .3 Structural Design Properties: Strength and related properties in accordance with CSA O86
 - .4 Sizes: Nominal dressed dimensions described in CSA O141 for surfaced dry conditions and wood species.
 - .2 Panel Grades: Provide panel products that are grade-marked by agencies recognized by CSA O325 and National Institute of Standards and Technology, Voluntary Product Standard PS 2 04 Performance Standard for Wood-Based Structural-Use Panels as modified by other listed CSA panel standards.
 - .3 Pressure treatments: To CAN/CSA O80 Series; clearly indicate, on the face or edge, labeling requirements in accordance with Wood Preservation Canada and CSA O322.
 - .1 Indicate:
 - .1 Name of registered treatment.
 - .2 Basic safety instructions.
 - .3 Consumer safety contact information.
 - .4 Fire-retardant wood treatments: To CAN/CSA O80 Series and tested in accordance with CAN/ULC S102 or CAN/ULC S102.2 for flame spread classifications and smoke developed indices; clearly indicate, on the face or edge, labeling requirements in accordance with Wood Preservation Canada.
 - .1 ULC label describing flame spread and smoke developed performance ratings.
 - .2 Name of registered treatment.
 - .3 Basic safety instructions.
 - .4 Consumer safety contact information.

2.2 PERFORMANCE CRITERIA

- .1 Plywood Grades: Provide plywood products in nominal dimensions required for the project; grade-marked by accredited agencies of the APA and that conform to the Canadian Plywood Grading Guide, and tolerances described for specific plywood Products below, and identified as follows:
 - .1 Name of Standard CSA O121 or CSA O151;
 - .2 Manufacturer's Mill Identification;
 - .3 Bond Quality (Exterior or Interior);

- .4 Commercial Species Grouping (DFP, CSP, ASP or HEM-FIR);
 - .5 Product Grade (SHG, SEL, SEL TF, G1S or G2S);
 - .6 Nominal Thickness; and
 - .7 Additional Grade or Product Designations (if applicable).
- .2 Lumber Grades: Provide lumber products that are all sides finished (S4S) in nominal dimensions required for the project; grade marked by accredited agencies of the Canadian Lumber Standards Accreditation Board and conform to National Grading Rules published by the National Lumber Grades Authority, and as follows:
- .1 Grading: Machine Grading, Visual Grading, or Both.
 - .2 Moisture Content: [Kiln Dry] [Air Dry], 19% or less.
 - .3 Structural Design Properties: Strength and related properties in accordance with CSA O86 and NLGA SPS 2.
 - .4 Sizes: Nominal dressed dimensions described in CSA O141 for surfaced dry conditions and wood species.
 - .5 Acceptable Alternative Products: Lumber products meeting requirements of the American Lumber Standards Committee designated ALS Program Lumber and that are accepted by the Canadian Lumber Standards Accreditation Board, may be acceptable for the Project when proof of compliance with strength and related properties meeting CSA O86 are submitted before purchasing any lumber products.

2.3 MATERIALS

- .1 Lumber Materials:
- .1 Light Framing: Provide Construction Grade with the following minimum properties:
 - .1 Sizes: Maximum 38-mm width by maximum 89-mm depth.
 - .2 Fingerjoined Materials: Not Allowed.
 - .3 Species Group: Spruce-Pine-Fir (SPF).
 - .2 Stud Framing: Provide stud grade with the following minimum properties:
 - .1 Sizes: 38-mm or 89-mm width by maximum 140-mm depth as noted on drawings.
 - .2 Fingerjoined Materials: Not Allowed.
 - .3 Species Group: [Spruce-Pine-Fir (SPF)].
 - .3 Strapping: Provide 19-mm deep x 38-mm wide [pressure preservative treated] materials as described above for stud framing and stud grade.
 - .4 Miscellaneous Framing: Provide furring, blocking, nailing strips, grounds, rough bucks, [cants,] curbs, fascia backing and sleepers, and other materials matching lumber used within framed construction; or use Light Framing, No. 2 Grade or better materials where lumber grade is not indicated.
- .2 Panel Materials:
- .1 Plywood Blocking and Backing Panels: Douglas Fir and Canadian Softwood Plywood using exterior grade adhesives meeting requirements of CSA O121 or CSA O151; kiln dry plywood to moisture content of 15% or less, and as follows:
 - .1 Concealed Blocking: Select Grade (SEL) Canadian Softwood Plywood).
 - .2 Exposed Panels and Panel Boards: Good One Side (G1S) Douglas Fir Plywood.

2.4 PRESSURE TREATED MATERIALS

- .1 Preservative treatments: Use pressure preservative treatments based on regional availability, use categories indicated on Drawings, and in accordance with CAN/CSA-O80.
- .1 UC1 interior, above-ground, normally dry conditions: Use ACQ, MCA, CA, or SBX wood treatments.
 - .2 UC2 interior, above-ground, damp conditions: Use ACQ, MCA, or CA, wood treatments.
 - .3 UC3.1 and UC3.2 exterior critical structural, above-ground, low potential for human contact: Use CCA, ACZA, PCP or CR wood treatments.

- .4 UC3.1 and UC3.2 exterior non-critical structure, above-ground, high potential for human contact: Use CA or MCA wood treatments.
- .5 UC4.1 exterior non-critical structure, ground contact or fresh water contact, low potential for human contact: Use CCA, CR or PCP wood treatments.
- .6 UC4.1 exterior non-critical structural, ground contact or fresh water contact, high potential for human contact: Use ACZA wood treatment.
- .7 UC4.1 exterior critical structural, ground contact or fresh water contact, high decay potential, low potential for human contact: Use CCA, CR or PCP wood treatments.
- .8 UC4.2 exterior permanent structural, ground contact or fresh water contact, high decay potential, low potential for human contact: Use CCA, CR or PCP wood treatments.
- .2 Fire retardant treatments:
 - .1 Provide UCF.1 pressure fire retardant treatments, as indicated on Drawings, in accordance with CAN/CSA-O80 Series and tested in accordance with CAN/ULC-S102 or CAN/ULC-S102.2:
 - .2 Fire-retardant treated plywood for interior use:
 - .1 Flame-spread rating: 150 maximum.
 - .2 Smoke-developed classification: 50 maximum.
 - .3 Kiln dry fire-retardant treated products after treatment to the following moisture contents:
 - .1 Plywood: 15%.

2.5 ACCESSORIES

- .1 Driven Fasteners: Steel nails, spikes, brads and staples meeting requirements of ASTM F1667. Ensure length is sufficient to penetrate connecting solid wood materials.
 - .1 Exterior Work: Hot-dipped galvanized.
 - .2 Interior High Humidity Work: Hot-dipped galvanized.
 - .3 Interior Work: Electroplated zinc plated, or cadmium plated.
- .2 Rough Hardware (Bolts, Nuts and Washers): Provide manufacturer recommended fastening devices and anchors meeting requirements of ASTM A307 and as follows:
 - .1 Ground Contact Materials: Stainless steel.
 - .2 Exterior Work: Hot-dipped galvanized.
 - .3 Interior High Humidity Work: Hot-dipped galvanized.
 - .4 Interior Work: Electroplated zinc plated, or cadmium plated.
- .3 Wood Screws: Steel screws meeting requirements of ASME B18.6.1 and as follows:
 - .1 Exterior Work: Galvanized, ceramic coated or stainless steel.
 - .2 Interior Work: Galvanized.
- .4 Screws for Fastening to Cold-Formed Metal Framing: Steel screws meeting requirements of ASTM C954, except for wafer heads and reamer wings whose length should be as recommended by screw manufacturer for material being fastened.
- .5 Prefabricated Metal Anchoring Systems, Framing Connectors and Hangers: Prefabricated hot-dipped zinc coated steel products tested or designed in accordance with CSA O86; types and configurations as indicated on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: Verify conditions of substrates previously installed are acceptable for product installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate [in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

- .1 Requirements:
 - .1 Accurately frame and properly assemble rough carpentry work
 - .2 Securely attach rough carpentry work to substrate by anchoring and fastening
 - .3 Include required nails, fastenings and other connectors
 - .4 Set rough carpentry to required levels and lines with members plumb, true to line, cut, and fitted
 - .5 Fit rough carpentry to other construction
 - .6 Scribe and cope as needed for accurate fit
 - .7 Locate furring, nailers, blocking, grounds, and similar supports as required when attaching to other construction.
 - .8 Do not use materials with defects that impair the quality of the rough carpentry or use pieces that are too small to use with a minimum number of joints or optimum joint arrangement.
- .2 Roof Framing, Parapets, Cant Strips and Plates:
 - .1 Construct wooden roof curbs around openings in the roof for vents, ducts, and other penetrations.
 - .2 Make curbs a minimum height of 200 mm above roof membrane; make base of curbs same thickness as insulation.
 - .3 Form sloped tops to wood parapet plates and wood up stands more than 38 mm wide to roofs that receive metal flashings; sloped not less than 2:12.
 - .4 Provide continuous wood backing for flashings.
 - .5 Provide solid wood or plywood sheathing and backing to receive membrane and metal flashings, conforming to CRCA Manual; fasten plywood sheathing securely to walls of parapets using mechanical fasteners; nails are not acceptable.
 - .6 Construct framing and blocking for membrane control joints conforming to CRCA Manual.
 - .7 Do not use pressure preservative treated wood when in direct contact with SBS adhered roof membranes.
- .3 Telecommunications and Data Panel Boards:
 - .1 Install 19-mm DFP G1S plywood on all walls in telephone [and data] rooms receiving wiring and equipment
 - .2 Minimum 1220-mm x 2440-mm panels on periphery walls over 300 mm wide, mounted 150 mm off of finished floor
 - .3 Coordinate installation and locations with Section 26 05 00 - Common Work Results for Electrical and Section 27 10 05 - Structured Cabling for Communications Systems:
 - .4 Paint panels with 2 coats of light-coloured fire-retardant paint finish as specified in Section [27 05 28 – Pathways for Communications Systems; coat all sides of panels (back, front and sides) to meet the intent of fire-resistance rated panel requirements and in accordance with ANSI/TIA/EIA 569–B standard requirements.
- .4 Provide electrical equipment backboards for mounting electrical equipment as indicated. Use 19-mm thick plywood on 19 x 38 mm furring around spacing, perimeter and at maximum 305 mm intermediate.

3.3 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Final Cleaning: Upon completion, remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by rough carpentry installation.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute (ANSI):
 - .1 ANSI/BHMA A156.9-2010, Cabinet Hardware.
 - .2 ANSI/BHMA A156.11-2014, Cabinet Locks.
 - .3 ANSI/BHMA A156.16-2013, Auxiliary Hardware.
 - .4 ANSI/BHMA A156.18-2012, Materials and Finishes.
 - .5 ANSI/BHMA A156.20-2006, Strap and Tee Hinges and Hasps.
 - .6 ANSI A208.1-2009, Particleboard.
 - .7 ANSI A208.2-2009, Medium Density Fiberboard for Interior Use.
 - .8 ANSI/HPVA HP-1-04, Standard for Hardwood and Decorative Plywood.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM E 1333-96(2002), Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates From Wood Products Using a Large Chamber.
 - .3 ASTM D 5116-06, Standard Guide For Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.
- .3 Architectural Woodwork Manufacturers' Association of Canada (AWMAC):
 - .1 Architectural Woodwork Standards, 2nd. Edition, 2014 (referred to hereinafter as "AWS").
- .4 Canadian Standards Association (CSA):
 - .1 CAN3-A172-M79(R1999), High Pressure Paper Base, Decorative Laminates.
 - .2 CSA B35.4-1972, Wood Screws.
 - .3 CSA-B111-1974(R2003), Wire Nails, Spikes and Staples.
 - .4 CSA-O115-M1982(R2001), Hardwood and Decorative Plywood.
 - .5 CSA-O121-08, Douglas Fir Plywood.
 - .6 CSA-O121-M1978(R2003), Douglas Fir Plywood.
- .5 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-19.22-M89, Mildew-Resistant Sealing Compound for Tubs and Tiles.
 - .2 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
- .6 National Hardwood Lumber Association (NHLA)
 - .1 Rules for the Measurement and Inspection of Hardwood and Cypress 1998.
- .7 National Electrical Manufacturers Association (NEMA)
 - .1 ANSI/NEMA LD-3-05, High-Pressure Decorative Laminates (HPDL).
- .8 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2003(R2007).
- .9 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for laminate, adhesive, and core materials and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements. Indicate VOC's for adhesives in g/L.
 - .3 Submit manufacturer's printed product literature for all hardware and fixings and include product characteristics, performance criteria, physical size, finish and limitations. Include installation instructions for each item of hardware.
 - .4 Submit product data for solid plastic surfaces, including installation instructions for solid polymer fabrications.
- .3 Shop Drawings:
 - .1 Shop drawings to include complete dimensioned drawings of each cabinetwork and millwork item, including locations of on-site joints in countertops, details of construction, profiles, jointing, fastening, location for rough-in of plumbing including sinks, faucets, strainers, and other related details.
 - .2 Indicate all materials, thicknesses, finishes and hardware.
 - .3 Indicate locations of all service outlets in millwork, typical and special installation conditions, and all connections, attachments and anchorage.
- .4 Samples:
 - .1 The accepted samples shall be the standard of acceptance for the work of this Section.
 - .2 Panel Material:
 - .1 Submit duplicate 300 x 300mm samples of panel showing finish on both sides, two finished edges and core construction.
 - .3 Cabinet Hardware:
 - .1 Provide a complete Cabinet and Miscellaneous Hardware Schedule for the project.
 - .2 Pay the cost of preparation of the Hardware Schedule and include in the Contract Price.
 - .3 Clearly indicate hardware proposed, including make, model, material, function, finish and all other pertinent information.
 - .4 The Consultant's review of the Hardware Schedule does not limit or release the Contractor from the responsibility to provide all necessary hardware and related components required for a complete installation as required by the authorities having jurisdiction.
 - .5 Submit duplicate representative samples of each hardware item, including brackets, fastenings and trim.
 - .6 Submit technical literature as necessary to fully inform the Consultant regarding hardware items proposed.
 - .7 Include installation instructions for each item of hardware.
 - .4 Plastic Laminate Counters:
 - .1 Submit duplicate colour samples of Plastic Laminate materials for colour selection.
 - .2 Submit samples of joints, edging, cutouts and profiles.
- .5 Maintenance Data:
 - .1 Provide maintenance data for plastic laminate work and plastic laminate counters for incorporation into the operation and maintenance manual specified in Section 01 78 00 "Closeout Submittals".

1.3 QUALITY ASSURANCE

- .1 Perform Work of this Section by single architectural wood casework fabricator with minimum 5 years of current architectural casework production experience and having completed minimum one project in the past 5 years with value within 20% of the cost of the work of this Section.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Protect cabinetwork against dampness during and after delivery.
- .2 Do not store or install materials in areas where relative humidity is less than 25% or greater than 60% at 22°C.
- .3 Store cabinetwork in ventilated areas, protected from extreme changes of temperature or humidity.
- .4 Cover finished laminated plastic surfaces heavy kraft paper or put in cartons during shipment. Protect installed laminated surfaces by approved means. Do not remove protection until immediately before final inspection.
- .5 Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations.
- .6 Store hardware in locked, clean and dry area.
- .7 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

1.5 WARRANTY

- .1 For the work of this Section, the 12 month warranty prescribed in the General Conditions of the Contract is extended to 5 years.
- .2 Warrant that plastic laminate finish will not warp, split, delaminate or open at joints.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Softwood lumber: Pine species: 5 to 10% moisture content, grades in accordance with AWS Section 3, as follows:
 - .1 Exposed Work: Premium Grade
 - .2 Semi exposed work: Custom Grade or better.
 - .3 Concealed work: Economy Grade or better.
 - .4 Finger-jointed lumber is not acceptable.
- .2 Hardwood lumber (exposed):
 - .1 Average moisture content 7% (minimum individual pieces 5%, maximum individual pieces 9%) in accordance with AWS Section 3, as follows:
 - .1 Clear or transparent finish exposed work: White Maple, Custom Grade.
 - .2 Concealed work or opaque finish: species at the option of the fabricator, Economy Grade or better.
- .3 Softwood plywood: Douglas Fir Plywood (DFP) to CSA-O121, FSC certified, G1S or G2S sanded grade, as applicable.
- .4 Hardwood plywood (drawers only): To CSA-Z809, specifications in accordance with AWS Section 4, HPVA Veneer Grade B.
- .5 MDF (medium density fibreboard) core: to ANSI A208.2, Grade 155, 19mm thick, density 740-770 kg/m³, or FSC certified.
 - .1 Medium density fibreboard performance requirements to: ANSI A208.2.

- .2 MDF resin to contain no added urea-formaldehyde.
- .6 Plastic Laminate for Flatwork to NEMA LD3:
 - .1 Type: General Purpose
 - .2 Grade: HGS
 - .3 Sheet Thickness: 0.048 inch nominal.
- .7 Plastic Laminate for post-forming work to NEMA LD3:
 - .1 Type: General Purpose
 - .2 Grade: HGP
 - .3 Sheet Thickness: 0.039 inch nominal.
- .8 Plastic Laminate Finish:
 - .1 PLAM-1: Lobby & Kitchen Cabinets:
 - .1 Manufacturer: Formica
 - .2 Colour: Scandi Rift Oak, Oiled Wood Finish
 - .2 PLAM-2: Washroom Vanity:
 - .1 Manufacturer: Formica
 - .2 Colour: Nero Ingo, Fenix^{NTM}
- .9 Nails and staples: CSA B111-1974, hot dipped galvanized for exterior work, and areas subject to high humidity, plain finish elsewhere.
- .10 Wood screws: to CSA B35.4, electroplated, type and size to suit application.
- .11 Draw bolts and splines for countertops: as recommended by fabricator.
- .12 Adhesives:
 - .1 Generally as recommended by the architectural woodwork fabricator.
 - .2 Laminated plastic adhesive: contact adhesive to CAN/CGSB-71.20.
- .13 Sealant caulking of back of countertops at wall: One-component, mildew resistant sealing compound for tubs and tiles to CAN-CGSB-19.22. Acceptable product: Tremsil 600. Colour to match adjacent materials to the approval of the Consultant.

2.2 MANUFACTURED CASEWORK

- .1 Fabricate casework in accordance with AWS Section 10 to Custom quality grade, flush overlay type, except where otherwise indicated.
- .2 Furring, blocking, nailing strips, grounds and rough bucks, sleepers and concealed framing: Softwood lumber, pine species.
- .3 Base: 19 mm DFP faced with room base material.
- .4 Concealed casework framing: Hardwood, species at the option of the fabricator.
- .5 Case bodies (ends, divisions, bottoms, shelves, backs):
 - .1 White Melamine with MDF core.
 - .2 Thicknesses:
 - .1 Sides: 19mm PLam with 3mm PLam edging on 4 edges
 - .2 Back: 19mm PLam
 - .3 Bottom: 19mm PLam with 3mm PLam edging
 - .3 Floor mounted cabinets to have an integral fir waterproof veneer core base.
- .6 Shelving: 19mm Plastic Laminate (PLam) with MDF core with 3mm PLam edging on 4 sides.

- .7 Applied cabinet doors:
 - .1 19 mm PLam with MDF core with 3mm integral PLam edging on 4 sides.
 - .2 Full height cabinet doors: 25 mm PLam with MDF core with 3mm integral PVC edging on 4 sides.
- .8 Drawers:
 - .1 Fabricate drawers to AWS Premium grade.
 - .2 Drawer fronts: 19 mm PLam with MDF core with 3mm integral PLam edging on 4 sides.
 - .3 Semi-exposed fronts, sides and backs: 16 mm thick birch plywood. Grain direction: longitudinal.
 - .4 Bottoms: 6 mm thick birch plywood: Grain direction: longitudinal.
 - .5 Edges of drawer sides and backs: Fill all voids and sand smooth to receive transparent finish.

2.3 CASEWORK FABRICATION

- .1 Fabricate casework in accordance with AWS Section 10 to Custom quality grade, double-front, flush overlay type, except where otherwise indicated.
- .2 Use dado construction for fixed shelves and intermediate gables. Use rabbet joint construction at top and bottom of end gables.
- .3 Shop install cabinet drawer hardware for doors, shelves and drawers. Recess shelf standards unless otherwise noted.
- .4 Except where otherwise indicated, all cabinet shelves shall be adjustable.
- .5 Provide cutouts for plumbing fixtures and fittings, inserts, appliances, outlet boxes, electric, telephone and computer cables, closed circuit TV cables and other fixtures. Install bushings at cable penetrations.
- .6 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.

2.4 HARDWARE

- .1 Manufacturers:
 - .1 This specification is based on the specified products which are selected to establish a standard of acceptance.
 - .2 Requests for substitutions will be considered. Acceptance of alternative products is subject to the approval of the Consultant.
 - .3 Use one manufacturer's product for all similar items.
- .2 Hardware Items:
 - .1 Lower Door and Drawer Pulls: Brushed Black Contemporary Aluminium Edge Pull, screw fasteners at 128 mm o.c, Matte Black.
 - .1 Standard of acceptance: Richelieu 9595,
 - .2 Upper cabinet door pulls: 100mm x 42mm x 17.8 Black anodized L pull with raised finger hold.
 - .1 Standard of acceptance: Richelieu #989880 with #10 finish.
 - .3 Hinges:
 - .1 Shall be European Style, Overlay Panel, 110 degrees opening, stainless steel body (brushed finish), three plan adjustable, "soft close" function, concealed hinges with screw on hinge crosses
 - .2 Number of hinges to suit configuration, door sizes, door thickness as recommended by the manufacturer.
 - .4 Drawer Hardware: Heavy duty, full extension, self-closing drawer slides, length to suit depth of drawer.
 - .1 Standard of Acceptance: Blum Metabox Series.

- .5 Shelf Support: Clear plastic support with steel pin for 5mm dia. hole.
 - .1 Standard of Acceptance: Richelieu #34004011.
- .6 Door and Drawer Bumpers: Two per door and drawer clear rubber.
- .7 Blind Corner Organizer
 - .1 Shape: Cloud
 - .2 Height: Two Tier
 - .3 Standard of Acceptance: Richelieu, Rev-A-Shelf Two-Tier Organizer for Blind Corner Cabinets

- .3 Installation Instructions:
 - .1 Provide manufacturer's instructions for proper installation of each hardware component.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Examine areas and conditions under which work is to be performed and notify the Consultant in writing of conditions detrimental to the proper and timely completion of the work.
- .2 Do not proceed with the work until unsatisfactory conditions have been corrected to the satisfaction of the installer.
- .3 Take field measurements to verify or supplement dimensions.
- .4 Commencement of the installation will be construed as acceptance of the site conditions and, thereafter, the Contractor shall be fully responsible for satisfactory work as specified herein.

3.2 INSTALLATION

- .1 Install architectural woodwork in accordance with Quality Standards of AWMAC.
 - .1 In the case of conflict between the Contract Documents and AWMAC requirements, the Contract Documents govern.
- .2 Install prefinished millwork at locations shown on drawings.
 - .1 Position accurately, level, plumb and straight.
- .3 Fasten and anchor millwork securely.
 - .1 Provide heavy duty fixture attachments for wall mounted cabinets.
- .4 Use draw bolts in countertop joints.
- .5 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, cabling, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.
- .6 Make allowances around perimeter where fixed objects pass through or project into laminated plastic work to permit normal movement without restriction.
- .7 Provide cutouts for inserts, grilles, appliances, outlet boxes and other penetrations. Round internal corners, chamfer edges and seal exposed core.
- .8 At junction of counter, backsplash, adjacent wall finish and at plumbing fixture cutouts, apply small bead of sealant. Refer to Section 07 92 00 "Joint Sealants".
- .9 Apply moisture barrier over wood framing members in contact with masonry or cementitious construction.

- .10 Fit hardware accurately and securely in accordance with manufacturer's directions. adjust operating parts for smooth, correct function.

3.3 PROTECTION

- .1 Protect installed work from damage.

3.4 CLEANING

- .1 Upon completion of the installation, remove from the premises all surplus material, dirt and debris caused by the work of this Section and leave the installation clean and ready for the intended use by the Owner.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 05 41 00 - Structural Metal Framing.
- .2 Section 06 10 53 - Miscellaneous Rough Carpentry.
- .3 Section 07 21 13 - Board Insulation.

1.2 REFERENCES

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE):
 - .1 ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International (ASTM):
 - .1 ASTM A792 - Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - .2 ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 National Fire Protection Association (NFPA):
 - .1 NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.
- .4 National Energy Code for Buildings (NECB):
 - .1 NECB SB-10 – Supplementary Standard.
- .5 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC-S134-13 - Standard Method of Fire Test of Exterior Wall Assemblies. (Note conducted on both combustible and non-combustible cladding.)

1.3 SUBMITTALS

- .1 Submit under provisions of Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Manufacturer's data sheets on each product to be used.
 - .2 Preparation instructions and recommendations.
 - .3 Storage and handling requirements and recommendations.
 - .4 Typical installation methods.
- .3 Verification Samples: Two representative units of each type, size, pattern and color.
- .4 Shop Drawings: Include details of materials, construction and finish. Include relationship with adjacent construction.

1.4 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum five years documented experience.
- .2 Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.

- .3 Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.
- .4 Mock-Up: Construct a mock-up with actual materials in sufficient time for Architect's review and to not delay construction progress. Locate mock-up as acceptable to Architect and provide temporary foundations and support.
 - .1 Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
 - .2 If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
 - .3 Retain mock-up during construction as a standard for comparison with completed work.
 - .4 Do not alter or remove mock-up until work is completed or removal is authorized.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 PROJECT CONDITIONS

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

1.7 WARRANTY

- .1 Manufacturer's standard limited warranty unless indicated otherwise.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- .1 This specification is based on 'IsoClips by Northern Facades'
- .2 Alternate Manufacturers:
 - .1 Thermal Clips ACS by Soprema
- .3 Requests for substitutions will be considered in accordance with provisions of Section 01 25 00 "Substitution Procedures". Acceptance of alternative products is subject to the approval of the Consultant.

2.2 THERMAL ISOLATION CLIP.

- .1 Performance and Design Requirements:
 - .1 High Load Capacity per Clip: Less clips may be required compared to synthetic or aluminum clips resulting in less thermal bridging.
 - .2 May assist achieving multiple LEED V4 credits as a component part of wall assembly.
 - .3 Built in slotted retaining tab to ease installation of girts.
 - .4 Mounting Orientation: The same regardless of horizontal or vertical girt orientation.
 - .5 Substrates: All, including concrete, concrete block, steel studs or wood.
 - .6 Effective Wall Assembly R-Value: As determined by Architect in combination with Insulation system.
 - .7 Accommodate a variety of wall depths and insulation thicknesses.

- .2 Product: 4.75 inch (121 mm) Thermal Isolation Clip: Assists in creating thermal break between interior and exterior of building. Reduces thermal transfer through building envelope.
 - .1 Standards Compliance:
 - .1 ASHRAE 90.1, NECB, SB-10 compliance, with thermal analysis available.
 - .2 NFPA 285: Pass.
 - .3 CAN / ULC S134-13: Pass.
 - .2 Clip Material: 14 ga ASTM A792 Galvalume or ASTM A653 Galvanized, steel.
 - .3 Thermal Isolator Pad: Glass fibre reinforced polyamide.
 - .4 Adjustment: Plus or minus 1/2 inch (13 mm) wall deviation. No shims required.
 - .5 Insulation Thickness Range: 5 to 8 inch (127 to 203 mm) of insulation.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 INSTALLATION

- .1 Install cladding support system components in accordance with manufacturer's written instructions, approved submittals, and the following:
 - .1 Install in proper relationship with adjacent materials.
 - .2 Install cladding support system assembly level, plumb, and square within 1/8 inch in 20 ft. (3.2 mm in 6.1 m) noncumulative allowable tolerance.
- .2 Install cladding support system in compliance with orientation, sizes, and locations as indicated.
 - .1 Use termination trim at rough openings to properly transition and enclose continuous insulation (CI) system to provide thermally broken transition from opaque wall assemblies.
 - .2 Trim to be covered by exterior cladding materials and flashings.

3.4 FIELD QUALITY CONTROL

- .1 Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.

3.5 CLEANING AND PROTECTION

- .1 Clean products in accordance with the manufacturer's recommendations.
- .2 Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

PART 1 GENERAL

1.1 DEFINITIONS

- .1 Thermal Resistance: Means long-term thermal resistance (LTTR) in accordance with CAN/ULC-S770 or ASTM C1303/C1303M.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM A653/A653M-20 Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
 - .2 ASTM A792/A792M-21a, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
 - .3 ASTM C208-12(2017)e2, Standard Specification for Cellulosic Fiber Insulating Board
 - .4 ASTM C578-19 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
 - .5 ASTM C591-21, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
 - .6 ASTM C612-14, Standard Specification for Mineral Fibre Block and Board Thermal Insulation
 - .7 ASTM C1126-19, Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
 - .8 ASTM C1289-21, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
 - .9 ASTM C1303/C1303M-19, Standard Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation
 - .10 ASTM D1621-16, Standard Test Method for Compressive Properties of Rigid Cellular Plastics
 - .11 ASTM D2842-19, Standard Test Method for Water Absorption of Rigid Cellular Plastics
 - .12 ASTM E84-21a Standard Test Method for Surface Burning Characteristics of Building Materials
 - .13 ASTM E96/E96M-21, Standard Test Methods for Water Vapour Transmission of Materials.
- .2 American Society of Heating Refrigeration and Air-Conditioning (ASHRAE):
 - .1 ASHRAE 90.1-2019(I-P), Standard 90.1-2019 (I-P Edition) -- Energy Standard for Buildings Except Low-rise Residential Buildings. (ANSI Approved; IES Cosponsored)
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)
- .4 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .2 CAN/ULC-S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials
 - .3 CAN/ULC-S604:2016, Standard for Factory-Built Type A Chimneys
 - .4 CAN/ULC-701.1:2017, Standard for Thermal Insulation, Polystyrene Boards
 - .5 CAN/ULC-S702-14, Standard for Mineral Fibre Insulation for Buildings
 - .6 CAN/ULC-S704-11, Standard for Thermal Insulation Polyurethane and Polyisocyanurate, Boards, Faced
 - .7 CAN/ULC S770-15, Standard Test Method for Determination of Long-term Thermal Resistance of Closed-Cell Thermal Insulating Foams

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of other Subcontractors adjacent and penetrating board insulation which must be completed before or after insulation work.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product literature, and data sheets for each type of board insulation. Include product characteristics, performance criteria, physical sizes, and limitations.
 - .2 Submit WHMIS SDS
- .3 Samples: When requested, submit sample 300 x 300 mm x full board thickness of each type of board insulation.
- .4 Certificates: When requested, submit manufacturer's product certificates certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .5 Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .6 Manufacturer's Instructions: Submit manufacturer's installation instructions.
- .7 Sustainable Design Submittals:
 - .1 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for the project.
 - .2 Regional Materials: submit evidence that project incorporates required percentage 10% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
 - .1 Deliver board insulation marked with its thermal resistance value, associated reference standard number, Type, and Class. Packaged in accordance with the associated reference standard.
- .2 Storage and Handling Requirements:
 - .1 Store materials in a clean, dry area and in accordance with manufacturer's recommendations.
 - .2 Store and protect plastic insulation from sunlight except as necessary during installation, protect from ignition sources, hydrocarbons, other petroleum derivatives, and other products that may cause degeneration.
- .3 Develop Construction Waste Management Plan related to Work of this.
- .4 Packaging Waste Management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal

PART 2 PRODUCTS

2.1 INSULATION

- .1 Below Grade Foundation (Both Sides):
 - .1 Extruded polystyrene (XPS): To CAN/ULC-701, for applications below grade, vertically.
 - .1 Type: 4.
 - .2 Compressive strength: Minimum 210 kPa.
 - .3 Board thickness: As indicated on Drawings.
 - .4 Size: To manufacturer's standard.
 - .5 Edges: Square ends, shiplap edges except where otherwise indicated.
- .2 Above Grade Exterior Walls (Office Side):
 - .1 Type 1: Semi-rigid wall thermal batts closest to exterior:
 - .1 Mineral wool fibre batt insulation for cavity application made from basalt rock and steel slag,
 - .1 Conforming to CAN/ULC-S702, Type 1, minimum 40% recycled content.
 - .2 Density to ASTM C303: greater than 69 kg/m³.
 - .3 Thermal Resistance to ASTM C: 0.75 m²K/W per 25.4 mm thickness.
 - .4 Thickness: As indicated on Drawings.
 - .5 Standard of Acceptance: Rockwool CavityRock Batt Insulation.
 - .2 Type 2: Semi-rigid wall thermal batts closest to interior:
 - .1 Type 2: Mineral wool fibre batt insulation for steel Z-Girt application made from basalt rock and steel slag,
 - .1 Conforming to CAN/ULC-S702, Type 1, minimum 40% recycled content.
 - .2 Density to ASTM C303: greater than 32 kg/m³.
 - .3 Thermal Resistance to ASTM C: 0.70 m²K/W per 245.4 mm thickness.
 - .4 Thickness: As indicated on Drawings.
 - .5 Standard of Acceptance: Rockwool MB Plus Batt Insulation.

2.2 ACCESSORIES

- .1 Thermally Broken Clip System: Low-conductivity thermal spacers, confirm clips with structural engineer and loads. Refer to Section 07 05 43 Cladding Support System
- .2 Girts: Galvanized steel, to ASTM A653, minimum 1.27 mm base metal thickness, structural steel (SS) classification, Grade 230, Z275 zinc coating.
- .3 Sub girts: Same properties as girts.
- .4 Screw Fasteners: Stainless steel type 316, type and length to suit application and to support all superimposed loads.
- .5 Insulation Fasteners:
 - .1 Insulation Clips: Impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation thickness, minimum 25 mm diameter self-locking washers.
 - .2 Mechanical Fasteners: Impact-resistant plastic fastener system specifically designed for installation of insulation boards, minimum 38 mm diameter, shaft length to suit insulation thickness and hot dipped galvanized fastener to suit substrate.
- .6 Perimeter Insulation Flashings: Coordinate supply of end closures and flashings for perimeter insulation system with Section 07 62 00 - Sheet Metal Flashing and Trim.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that conditions of substrate previously installed are clean, dry, smooth, and acceptable for application of board insulation in accordance with manufacturer's instructions.
 - .1 Inspect substrates in presence of Consultant.
 - .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 - GENERAL

- .1 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .2 Fit insulation tight around penetrating electrical boxes, plumbing piping heating pipes, and ducts, around exterior doors and windows and other protrusions.
- .3 Cut and trim insulation neatly to fit spaces. Butt joints tightly.
- .4 In multi-layered applications, offset vertical and horizontal joints.
- .5 Use only insulation boards free from chipped or broken edges.
- .6 Use largest possible boards to reduce number of joints.
- .7 In multiple layer applications oOffset both vertical and horizontal joints
- .8 Do not enclose, cover, or perform backfilling of insulation until it has been reviewed and accepted by [Departmental Representative] [DCC Representative] [Consultant].

3.3 INSTALLATION - RIGID INSULATION

- .1 Install mineral fibre board insulation with insulation clips and disks, 2 per 600 x 1200 mm board minimum, fit boards tight, cut off fastener spindle approximately 3 mm beyond disk.

3.4 INSTALLATION - PERIMETER FOUNDATION INSULATION

- .1 Interior application: Extend boards as indicated on Drawings, install on inside face of perimeter foundation walls.
- .2 Exterior application: extend boards as indicated on Drawings. Install on exterior face of perimeter foundation wall with adhesive.

3.5 INSTALLATION - CAVITY WALL INSULATION

- .1 Install mineral fibre insulation boards on outer surface of inner wythe of wall cavity over impaling clips.

3.6 INSTALLATION – ROOFING INSULATION

- .1 Refer to Section 07 52 00 - Modified Bituminous Membrane Roofing.

3.7 CLEANING

- .1 Progress Cleaning: Perform in accordance with Section 01 74 00 - Cleaning.
- .2 Final Cleaning: Perform in accordance with Section 01 74 00 - Cleaning] upon completion.
- .3 Waste Management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal.

3.8 PROTECTION

- .1 Temporarily protect installed board insulation from inclement weather and sunlight in excess of 12 weeks.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C167-18, Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations
 - .2 ASTM C423-17 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - .3 ASTM C553-19, Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications
 - .4 ASTM C665-17, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - .5 ASTM C1320-20, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction
 - .6 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
 - .7 ASTM E413-16, Classification for Rating Sound Insulation
 - .8 ASTM F1667-18a, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples
- .2 CSA Group (CSA):
 - .1 CSA B111-1974, Wire Nails, Spikes and Staples
 - .2 CSA B149 PACKAGE-20, Consists of B149.1, Natural Gas and Propane Installation Code and B149.2, Propane Storage and Handling Code
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)
- .4 Underwriters Laboratories of Canada (ULC):
 - .1 ULC 102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies (CAN/ULC S102)
 - .2 ULC 114-18, Standard Method of Test for Determination of Non-Combustibility in Building Materials
 - .3 ULC 604, Standard for Factory-Built Type A Chimneys (CAN/ULC-S604-16)
 - .4 ULC 702, Standard for Mineral Fibre Insulation for Buildings (CAN/ULC-S702-15)

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate building envelope commissioning with Section 01 91 13 – General Commissioning Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Submit manufacturer's instructions, product literature and data sheets for blanket insulation. Include product characteristics, performance criteria, physical sizes, and limitations.
- .3 Certificates: When requested, submit manufacturer's product certificates certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Test Reports: When requested, submit certified test reports showing compliance with specified performance characteristics and physical properties.

- .5 Sustainable Design Submittals: Submit in accordance with Section.
 - .1 Recycled Content: Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of [post-consumer] [and] [post-industrial] content, and total cost of materials for the Project.
 - .2 Regional Materials: submit evidence that project incorporates required percentage of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for the Project.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in a clean dry location and in accordance with manufacturer's recommendations.
- .3 Develop Construction Waste Management Plan related to Work of this Section.
- .4 Packaging Waste Management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 INSULATION

- .1 Wet/Humid Locations:
 - .1 Batt and blanket mineral fibre: Non-combustible, stone wool batt insulation to ASTM C665.
 - .1 Type: 1.
 - .2 Fire performance:
 - .1 Non-combustibility: To CAN/ULC S114.
 - .1 Flame spread: 0
 - .2 Smoke developed: 5
 - .3 Surface Burning Characteristics: To CAN/ULC S102.
 - .1 Flame spread: 0
 - .2 Smoke developed: 0
 - .4 Density: 2.5 lbs/ft³ (40 kg/m³) to ASTM C167
 - .5 Thickness: as indicated.
 - .6 Acceptable Manufacturers:
 - .1 Roxul AFB insulation by Rockwool
 - .2 Thermafiber SAFB by Owens Corning
 - .3
- .2 Dry Locations Only:
 - .1 Fibrous Glass Acoustical Insulation: Un-faced, to ASTM E413 and ULC S702.1.
 - .1 Type: 1.
 - .2 Thickness: as indicated on Drawings.
 - .3 Acceptable Manufacturer:
 - .1 Quietzone Pink Next Gen. Fibreglas Insulation by Owens Corning
 - .2 Formaldehyde-Free Fibreglass Insulation by Johns Manville
 - .3

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that conditions of substrate previously installed are acceptable for blanket insulation application in accordance with manufacturer's instructions.
 - .1 Verify all in wall construction is complete.
 - .2 Verify building substrates are dry.
 - .3 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .4 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSULATION INSTALLATION

- .1 Install insulation to maintain continuity of thermal protection to building elements and spaces and to ASTM C1320.
- .2 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .3 Fill stud space of interior framed walls with insulation full depth of stud.
- .4 Do not compress insulation to fit into spaces.
- .5 Do not enclose insulation until it has been reviewed and is acceptable by Consultant.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 Section 07 21 00 - Building Insulation
- .2 Section 07 27 00 - Air Barriers and Waterproofing
- .3 Section 07 92 00 - Joint Sealants.
- .4 Section 08 11 13 - Metal Doors and Frames.
- .5 Section 08 36 13.02 - Insulated Metal Section Door
- .6 Section 08 41 13 - Aluminum Doors and Frames.
- .7 Section 08 51 13 - Aluminum Windows.

1.2 REFERENCES

- .1 Underwriters' Laboratories of Canada (ULC):
 - .1 CAN/ULC-S102-03, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 SUBMITTALS

- .1 General: Submit each item in this Article according to the Conditions of the Contract and the applicable Division 01 Specification Sections.

1.4 ENVIRONMENTAL REQUIREMENTS

- .1 Apply insulation only when surfaces and ambient temperatures are within the manufacturer's prescribed limits.

1.5 DELIVERY, STORAGE & HANDLING

- .1 Deliver products in original unopened packaging with legible manufacturer's identification.
- .2 Store materials in strict accordance with the manufacturer's recommendations.

1.6 COMPATIBILITY

- .1 Provide written certification, signed by the insulating sealant manufacturer, that sealant is fully compatible with the building air/vapour barrier membrane. Confirm that the membrane will not shrink and pull the membrane away from its substrate.

PART 2 PRODUCTS

2.1 MATERIAL

- .1 Foam insulating sealant: Two-component polyurethane foam insulating sealant, ULC Class I (flame spread of 25 or less) to CAN\ULC-S102.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Examine areas and conditions under which work is to be performed and notify the Consultant in writing of conditions detrimental to the proper and timely completion of the work.
- .2 Ensure that surfaces are free of dust, oil, grease and other loose debris which may impair bond.
- .3 Do not proceed with the work until unsatisfactory conditions have been corrected to the satisfaction of the installer.
- .4 Commencement of the installation will be construed as acceptance of the site conditions and, thereafter, the Contractor shall be fully responsible for satisfactory work as specified herein.

3.2 PROTECTION

- .1 Provide suitable protective masking to adjacent exposed surfaces.

3.3 FOAM INSULATING SEALANT APPLICATION

- .1 Apply foam insulating sealant in strict accordance with the manufacturer's printed directions, using dispensing gun from material manufacturer. Fill all voids in the exterior wall insulation with sealant.
- .2 Apply in all locations where required to maintain the continuity of the insulation and/or the vapour barrier, including, but not necessarily limited to the following:
 - .1 Sealing voids in the exterior envelope of the building and at all locations where the continuity of the insulation is interrupted.
 - .2 Sealing at junctions between materials and components which comprise the air barrier as required to maintain continuity of the air barrier.
 - .3 All locations indicated on the drawings.
- .3 Note that this material expands 2.5 times its original volume when applied. Do not overfill voids.
- .4 If necessary, apply in several layers, each successive layer being allowed to cure before next layer is applied.
- .5 Curing may be accelerated in deep cavities by slight moistening of surrounding surfaces prior to application.
- .6 While curing, foam to be tooled, if required.
- .7 If leakage occurs after curing, cut back flush with surrounding surfaces or recess to sufficient depth to provide for finishing caulking.

3.4 CLEANING

- .1 Upon completion of the work of this Section remove from the premises all surplus material, dirt and debris caused by the work of this Section and leave the installation clean.
- .2 Remove masking and temporary protection from adjacent surfaces.
- .3 Clean and make good any damage to adjacent surfaces caused by the work of this Section.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM E84-21, Standard Test Method for Surface Burning Characteristics of Building Materials
 - .2 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials
 - .3 ASTM E154/E154M-08a(2019), Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
 - .4 ASTM E1643-18a, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
 - .5 ASTM E1745-17, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
 - .6 ASTM E1993/E1993M-98(2020), Standard Specification for Bituminous Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction
 - .2 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for [vapour retarders] and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit one electronic copy of WHMIS SDS in accordance with Section 01 35 29 - Health, Safety, and Emergency Response Procedures.
- .3 Certificates:
 - .1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates required percentage 10% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.3 QUALITY ASSURANCE

- .1 Mock-Ups:
 - .1 Submit mock-ups in accordance with Section 01 43 00 - Quality Assurance.
 - .2 Construct mock-up of sheet vapour barrier installation including one lap joint, one inside corner and at one electrical box. Mock-up may be part of finished work.
 - .3 Mock-up will be used to judge quality of work, substrate preparation, and material application.
 - .4 Locate where directed.
 - .5 Consultant will require minimum 24 hours to review the mock-up.
 - .6 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .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, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect specified materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 SHEET VAPOUR BARRIER

- .1 Underslab Plastic Sheet Vapour Retarder: High density, puncture resistant polyolefin resin sheet in accordance with ASTM E1745 and CAN/CGSB-51.34, and as follows:
 - .1 Thickness: 0.25 mm
 - .2 Vapour Permeance: Nominal ≤ 0.02 Perms maximum
 - .3 Tensile Strength and Puncture Resistance: ASTM E1745 Class A minimum
 - .4 Acceptable Manufacturer:
 - .1 Perminator 10 MIL by W.R. Meadows
 - .2 Viper II by Soprema

2.2 ACCESSORIES

- .1 Fasteners: Provide non-corrosive metal screws, nails, plastic clips and other fasteners as recommended by vapour retarder manufacturer required for complete installation of Work.
- .2 Joint sealing tape: High density, air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.

- .3 Sealant: Asbestos free non hardening sealant, compatible with vapour retarder materials, recommended by vapour retarder manufacturer. To Section 07 92 00 - Joint Sealants.
- .4 Staples: minimum 6 mm leg.
- .5 Substrate Crack Filler: Closed cell foam backer rod.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for vapour retarder installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

- .1 Ensure services are installed and inspected before installation of retarder.
- .2 Install sheet vapour retarder on warm side of exterior [wall] [ceiling] [and floor] assemblies before installation of [gypsum board] to form continuous retarder.
- .3 Use sheets of largest practical size to minimize joints.
- .4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

3.3 EXTERIOR SURFACE OPENINGS

- .1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

3.4 PERIMETER SEALS

- .1 Seal perimeter of sheet vapour barrier as follows:
 - .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
 - .2 Lap sheet over sealant and press into sealant bead.
 - .3 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.5 LAP JOINT SEALS

- .1 Seal lap joints of sheet vapour barrier as follows:
 - .1 Attach first sheet to substrate.
 - .2 Apply continuous bead of sealant over solid backing at joint.
 - .3 Lap adjoining sheet and press into sealant bead in accordance with manufacturer's requirements.
 - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.6 INSTALLATION: UNDERSLAB SHEET VAPOUR BARRIER

- .1 Install vapour barrier in accordance with manufacturer's written instructions and ASTM E1643, and generally as follows:
 - .1 Unroll vapour barrier with the longest dimension parallel to direction of concrete placement.
 - .2 Lap vapour barrier onto face of grade beams.
 - .3 Overlap joints in accordance with manufacturer's requirements.
 - .4 Seal penetrations including pipe and conduit risers in accordance with manufacturer's written instructions.
 - .5 Make no additional penetrations except as required for placing of reinforcing steel and permanent utilities.
- .2 Repair damaged areas by cutting patches of vapour barrier membrane; sized to overlap damaged area, and tape all sides using manufacturer's required tape.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
- .2 Final Cleaning: remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning upon completion.
 - .1 Remove insulation material spilled during installation and leave work area ready for application of wall board.
- .3 Waste Management: perform in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-19.24M, Multi-Component, Chemical Curing Sealing Compound.
 - .2 CGSB 19-GP-14M, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations. Product characteristics.
- .3 Quality Assurance Submittals: submit following in accordance with Section 01 45 00.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Applicator: company specializing in performing work of this section with minimum five years' experience with installation of air/vapour barrier systems.
 - .1 Completed installation must be approved by the material manufacturer.
 - .2 Applicator: company:
 - .1 Currently licensed by Canadian certifying organization.
 - .2 Must maintain their license throughout the duration of the project.
 - .3 Approved by Manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Clean spills and leave area as it was prior to spill.

1.5 AMBIENT CONDITIONS

- .1 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.
 - .2 Ventilate enclosed spaces.
 - .3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.
-

1.6 WARRANTY

- .1 Provide a written warranty for work of this section from Manufacturer for failure due to defective materials and from contractor for failure due to defective installation workmanship for five (5) years respectively.
- .2 To include coverage of installed sealant and sheet materials which:
 - .1 Fail to achieve air tight and watertight seal.
 - .2 Exhibit loss of adhesion or cohesion.
 - .3 Do not cure.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

- .1 Cold Fluid-Applied Waterproofing (Below Grade): Single component, asphalt emulsion formulated for application to damp and green concrete.
 - .1 Thickness: 1.5mm (60mils) min.
 - .2 VOC Content: Less than 72 g/L.
 - .3 Elongation, ASTM D412: 800%
 - .4 Low Temperature Flexibility and Crack Bridging, ASTM C 836: Pass.
 - .5 Peel Adhesion, ASTM C836: Pass.
 - .6 Acceptable Manufacturers:
 - .1 MiraSEAL by Henry Company
 - .2 Colphene LM 3200 by Sopreman
 - .3 TREMproof 260 by Tremco, Inc.,
 - .4 MEL-ROL LM by W.R. Meadows.
- .2 Sheet Applied Waterproofing Membrane (Below Grade): Self-adhering waterproofing membrane consisting of SBS modified bitumen and a cross-laminated polyethylene film, having the following properties
 - .1 Thickness: 1.5mm (60 mils)
 - .2 Water Vapour Transmission (ASTM E96): 1.14 ng/Pa.m².s., (0.02 perms)
 - .3 Peel Strength (ASTM D903): 1576N/m
 - .4 Minimum Puncture Resistance – Membrane (ASTM E154): 222 N/m
 - .5 Hydrostatic Head (ASTM D1876): 70m of Water
 - .6 Moisture Absorption (ASTM D570): 0.1% Maximum
 - .7 Tensile Strength (ASTM D412-modified): 2.24 MPa
 - .8 Elongation (ASTM D412-modified): 300%
 - .9 Acceptable Manufacturers:
 - .1 Blueskin WP200 by Henry Company.
 - .2 Colphene 3000 by Soprema
 - .3 TREMPProof 560A by Tremco Inc.
 - .4 MEL-ROL by W.R. Meadows
- .3 Above Grade: Sheet air/vapour barrier membrane, SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film with the following physical properties:
 - .1 Thickness: 1.0 mm (40 mils),
 - .2 Air leakage: <0.005 L/s.m² @ 75 Pa to ASTM E283-91,
 - .3 Tested to ASTM E 2357 for the air barrier assembly,
 - .4 Water vapour permeance: 1.6 ng/Pa.m².s (0.03 perms) to ASTM E96,
 - .5 Low temperature flexibility: -30 °C to CGSB 37-GP-56M,
 - .6 Elongation: 200% to ASTM D412-modified.
 - .7 Acceptable Manufacturers: Material: Blueskin SA, SA LT or approved equivalent.

- .4 Through-wall flashing:
 - .1 Flexible flashing:
 - .1 Materials: pressure-sensitive membrane of SBS rubberized asphalt fully laminated to a yellow film of crossed polyethylene compatible with air barriers made the same way.
 - .2 Dimensions: Min. strip 1.0 mm thick x 300mm or 450mm.
 - .3 Acceptable Material: BlueSkin TWF membrane by Bakor or approved equivalent.
 - .2 Rigid support under the flexible flashing: flashing in galvanized steel with throat. 0.607 mm thick.
- .5 Preformed Accessories: Standard or customized three-dimensional shapes as required to form a complete flashing system with preformed corners, end dams, other special shapes, and seaming materials; all provided by flashing sheet manufacturer.

2.2 SEALANTS

- .1 Sealants in accordance with Section 07 92 00.
- .2 Butyl Sealant Type A: CGSB 19-GP-14M.
- .3 Rubberized sealant: One-part, thermoplastic rubber based sealant, as recommended by the membrane manufacturer. Acceptable product: Bakor Polybitume, supplied in caulking tubes.
- .4 Primer: as recommended by sealant manufacturer.
- .5 Substrate Cleaner: non-corrosive type recommended by sealant manufacturer and compatible with adjacent materials.

2.3 ADHESIVES AND PRIMERS

- .1 Mastic Adhesive Type 1: compatible with sheet seal and substrate, thick mastic of uniform knife grade consistency.
- .2 Adhesive Type 2: compatible with sheet seal and substrate, permanently non-curing.
- .3 Sheet membrane primer: as recommended by the membrane manufacturer for each specific application and to meet low VOC targets.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 EXAMINATION

- .1 Verify that surfaces and conditions are ready to accept work of this section.
- .2 Ensure surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.
- .3 Report unsatisfactory conditions to Consultant in writing.
- .4 Do not start work until deficiencies have been corrected. Beginning of Work implies acceptance of conditions.

3.3 PREPARATION

- .1 Remove loose or foreign matter, which might impair adhesion of materials.
- .2 Ensure substrates are clean of oil or excess dust; masonry joints struck flush, and open joints filled; and concrete surfaces free of large voids, spalled areas or sharp protrusions.
- .3 Ensure substrates are free of surface moisture prior to application of self-adhesive membrane and primer.
- .4 Ensure metal closures are free of sharp edges and burrs.
- .5 Prime substrate surfaces to receive adhesive and sealants in accordance with manufacturer's instructions.

3.4 INSTALLATION

- .1 Install materials in accordance with manufacturer's instructions
- .2 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- .3 Provide strips of air barrier material where indicated and wherever necessary to maintain the continuity of the air barrier at the interface between different construction assemblies.
- .4 Use transition strips where necessary to form a continuous air seal to all window and door frame sections and other penetrations. Install 300 mm strip of membrane to effect tie-in. Overlap membrane minimum 75 mm.

3.5 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .2 Testing
 - .1 Air leakage testing as directed by Commissioning Agent and paid for by Contractor will be performed by professional testing agency for the locations selected at random for penetrations, laps, corners, etc.
 - .2 Conform to Test standards E283 (lab) and E783 (field) for test pressures and maximum allowable air leakage rate.
 - .3 Testing will be witnessed by Commissioning Agent and test reports will be signed by tester, site representative and contractor.
 - .4 Inform Commissioning Agent 48 hours prior to required testing.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 00.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.7 PROTECTION OF WORK

- .1 Do not permit adjacent work to damage work of this section.
- .2 Ensure finished work is protected from climatic conditions.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 07 62 00 – Sheet Metal Flashing and Trim

1.2 REFERENCE STANDARDS

- .1 The Aluminum Association, Inc. (AA):
 - .1 AA DAF45-03, Designation System for Aluminum Finishes
- .2 ASTM International (ASTM):
 - .1 ASTM A167-99, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - .2 ASTM A240/A240M-20a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - .3 ASTM A480/A480M-20a, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
 - .4 ASTM A653/A653M-20, Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
 - .5 ASTM D523-14, Standard Test Method for Specular Gloss
 - .6 ASTM D822/D822M-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
 - .7 ASTM D1781-98, Standard Test Method for Climbing Drum Peel for Adhesives
 - .8 ASTM E84-21, Standard Test Method for Surface Burning Characteristics of Building Materials
- .3 Canadian General Standards Board (CGSB):
 - .1 CGSB 19-GP-14M-76, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing
- .4 Green Seal Environmental Standards:
 - .1 Standard GS-11-15, Standard for Paints, Coatings, Stains and Sealers
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)
- .6 South Coast Air Quality Management District (SCAQMD), California State:
 - .1 SCAQMD Rule 1168-17, Adhesives and Sealants Applications

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings: convene meeting one week before beginning work of this Section and on-site installation, with contractor, affected Subcontractors and Consultant in accordance with Section 01 31 19 - Project Meetings:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other Subcontractors.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product literature for cladding system materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS SDS - Safety Data.
- .3 Shop Drawings:
 - .1 Shop drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate dimensions and thickness of panels, fastening and anchoring methods, detail and location of joints and gaskets, thermal movement provision, wall openings, head, jamb and sill details, materials and finish, compliance with design criteria and requirements of related work.
- .4 Samples:
 - .1 Submit duplicate 100 x 100 mm samples of wall system, representative of materials, finishes and colours.
- .5 Quality assurance submittals: submit following in accordance with Section 01 43 00 - Quality Assurance.
 - .1 Certificates: submit certificates signed by manufacturer certifying that composite wall panels comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
 - .3 Manufacturer's Site Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - SITE QUALITY CONTROL.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer: company specializing in producing metal wall panels with 5 years documented experience with sufficient capacity to produce and deliver required units without causing delay in Work.
 - .2 Installer: person specializing in metal wall panel installations with 5 years documented experience.
- .2 Mock-ups: construct mock-ups in accordance with Section 01 43 00 - Quality Assurance and to requirements supplemented as follows:
 - .1 Provide mock-up for evaluation of surface finishes and workmanship.
 - .2 Provide initial production units for job-site assembly with other materials for review.
 - .3 Coordinate type and location of mock-ups with project requirements.
 - .4 Do not proceed with remaining work until workmanship, colour, and finish are reviewed by Consultant.
 - .5 Refinish mock-up area as required to produce acceptable work.
 - .6 Approved mock-up may [not] remain as part of finished work.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Do not expose panels with strippable film to direct sunlight or extreme heat.
- .3 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 19 - Waste Management and Disposal.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

1.7 WARRANTY

- .1 Painted Finish Coatings Manufacturer/Applicator to Provide Twenty (20) Year Warranty of the Factory Applied Finish.
 - .1 WILL NOT chip, crack or peel (lose adhesion) but does not include minute fracturing which may occur in proper fabrication of building parts.
 - .2 WILL NOT chalk in excess of ASTM D-4214-89 number eight (8) rating, determined by the procedure outlined in ASTM D-4214-89 specification test.
 - .3 WILL NOT change color more than five (5) Delta-E Hunter units (square root of the sum of square Delta-L, Delta-A and Delta-B) as determined by ASTM method D-2244. It is acknowledged that fading or color changes may not be uniform if the surfaces are not equally exposed to the sun and elements.
- .2 Contractor: 5-year labor warranty for panel installation, including, flashings, sealants, fasteners, and accessories to remain watertight and weatherproof

PART 2 PRODUCTS

2.1 GENERAL

- .1 This specification is based on Aluminum Panel System as manufactured by Alutech, Model: 306.
- .2 Subject to compliance with the specification requirements, equivalent products by the following manufacturers are acceptable alternatives:
 - .1 NorthClad, AL-PR Series
 - .2 Kanalco
 - .3 Alumitex
- .3 All components of the roofing system shall be obtained from or approved by a single manufacturer.

2.2 SYSTEMS

- .1 Aluminum Wall Panels: Plate aluminum wall panel on perimeter extrusion, dry joint, pressure-equalized rainscreen system: Install over substrate system.

2.3 PERFORMANCE/DESIGN CRITERIA

- .1 Maximum deflection not to exceed L/180 under system's own weight plus wind load (positive and negative) loads acting normal to the plane in accordance with the Building Code Climatic Data, wind load 1:30 years.

- .2 Calculate live load deflections in accordance with CSSBI 20M, as modified by the requirements of this Section.
- .3 Design metal cladding to allow for thermal movement of component materials caused by variation in ambient temperature range of 80°C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- .4 Maximum deviation from vertical and horizontal alignment of erected panels: 1 to 1000.
- .5 Include expansion joints to accommodate movement in wall system and between wall system and building structure, where these movements are caused by deflection of building structure, and accommodate these movements, without permanent distortion, damage to infills, racking of joints, breakage of seals, or water penetration.
- .6 Provide for positive drainage to the exterior of all water entering or condensation occurring within the system.
- .7 Final review and acceptance of work completed by this Section shall be carried out by the manufacturer's representative, the Consultant, Contractor and the Subcontractor.

2.4 MATERIALS

- .1 Composition:
 - .1 Panel Skin Material to ASTM B209: 0.125 inch thickness, Aluminum Association specification sheet 3003- H14/5052-H32.
 - .2 Aluminum Extrusions: ASTM B221 alloy 6063 T6 and 6005A T61.
- .2 Stiffeners:
 - .1 Alloy: AA 6063 T5.
 - .2 Colour: Mill finish.

2.5 ACCESSORIES

- .1 Fasteners:
 - .1 Supply Fasteners and clips tested to meet provisions of this section, as approved by fastener manufacturer and engineer of record.
 - .2 Concealed Fasteners: Non-corrosive fasteners, and as instructed by engineer of record.
 - .3 Fastener Lengths: Penetrate cold-formed metal framing and subgirts, and other metal framing systems in accordance with the recommendations of engineer of record.
- .2 Concealed sealants: one-component, butyl-polyisobutylene polymer base, solvent curing to CGSB 19-GP-14M.
 - .1 Maximum VOC limit [250] g/L [to SCAQMD Rule 1168].
- .3 Exposed sealants: one-component, silicone base, solvent curing, colour to match panel.
 - .1 Maximum VOC limit [250] g/L [to SCAQMD Rule 1168].
- .4 Isolation Tape: Manufacturers standard material for separating dissimilar metals from direct contact.
- .5 Stiffeners, as required: Minimum 25 mm x 25 mm aluminum, bonded to the full length of face sheet using double sided high bond isolating tape to prevent weather staining and frost lines to the face of the panel. Bonding tape to be protected with continuous bead of caulking on both sides of stiffeners, type as recommended by manufacturer.

- .6 Flashings: Fabricate flashing from 1.57 mm minimum thickness aluminum sheet IN ACCORDANCE WITH Section 07 62 00 – Sheet Metal Flashing and Trim. Where exposed to view, finish to match adjacent panels. Provide lap strip under flashing at abutted conditions; with lapped surfaces sealed with a full bed of non-hardening sealant.

2.6 FABRICATION

- .1 Back-stiffen Aluminum panels to maintain flatness tolerances.
 - .1 Not to exceed L/175 panel dimension in width and length for panel bow.
- .2 Allow for field adjustments as recommended by the manufacturer where final dimensions cannot be established by field measurement before completion of panel manufacturing.
- .3 Eliminate all warping and/or bucking in panel lines, breaks, and angles. All components shall be factory fabricated ready for site installation. All components shall match quality and installation of accepted mock up specified above.
- .4 Fabrication Tolerances:
 - .1 Panel bow: maximum 0.8% of panel dimension in width and length.
 - .2 Panel dimensions: where final dimensions cannot be established by site measurement before completion of panel manufacturing, make allowance for site adjustments as recommended by manufacturer.
 - .3 Panel lines, breaks and angles: sharp, true and surfaces free from warp or buckle.
 - .4 Panel shall be visually flat.
 - .5 Panel surfaces shall be free of scratches or marks caused during fabrication.

2.7 ANODIZED FINISHES

- .1 Factory Finish for Wall Panel:
 - .1 Weather Face: Polyvinylidene Fluoride (PVDF) spray coating with 70 percent Kynar® 500 resin content.
 - .2 Number of Coats: 4-Coat, Coating shall be factory applied on a continuous process paint line. Coating shall consist of a 0.2 mil prime coat, a 0.75 mil barrier coat, a 0.75 mil metallic/color coat containing 70 percent Kynar® resins, and a 0.5 mil clear coat containing 70 percent Kynar® resins (Note; mil thickness is approximate).
 - .3 Relevant to the color selected, material to be painted in accordance with either AAMA specification 2604 or 2605
 - .4 Colour: to be chosen by Consultant from Manufacturers Full & Custom Range.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Before installation examine alignment of substrate and notify Consultant in writing if substrate does not comply with requirements of panel manufacturer.

3.2 INSTALLATION

- .1 Install composite panels in accordance with manufacturer's written instructions and shop drawings.
 - .1 Allow for thermal movement.
- .2 Erect panels plumb, level, and true.

- .3 Do not install component parts that are observed to be defective, including warped, bowed, dented, scraped and broken members.
- .4 Separate dissimilar metals; use appropriate gasket and fasteners to prevent corrosive or electrolytic action between metals.
- .5 Install flashings to divert all moisture and condensation to exterior. Trim and flash around doors, louvers, and windows. Use only membrane flashing supported by insulation per architectural details.
- .6 Remove strippable coating from panels as they are installed.
- .7 Tolerances:
 - .1 Maximum variation from plane or location shown on shop drawings: 10 mm/10 m of length and up to 20 mm/100 m.
 - .2 Maximum deviation for vertical member: 3 mm in an 8.5 m run.
 - .3 Maximum deviation for a horizontal member: 3 mm in an 8.5 m run.
 - .4 Maximum offset from true alignment between two adjacent members abutting end to end, in line: 0.75 mm.

3.3 METAL WALL PANELS

- .1 Do not stretch or compress.
- .2 Secure panel in place with panels aligned and without warp or deflection.
- .3 Make cutting and fitting neat, square, and true. Where required saw cut, de-burr edges, and clean filings from adjacent surfaces. No torch cutting permitted.

3.4 FLASHINGS AND TRIM

- .1 Install flashings and trim as part of manufacturer system as necessary to seal and close ends and to restrict water penetration behind wall panels.
- .2 Thermal Movement: Install flashing and trim systems to allow unrestricted thermal movement of metal panels on attachment clips.
- .3 Penetrations: Install per weather resistive barrier manufacturer instructions.
- .4 Metal Flashing:
 - .1 Detail per metal panel manufacturer's instructions.
 - .2 Make overlaps minimum 4 inches.
- .5 Cutting and Fitting: Make neat, square and true. De-burr edges, and clean filings from adjacent surfaces.

3.5 ADJUSTING

- .1 Correct identified defects and irregularities.
- .2 Replace damaged, soiled and discolored work.

3.6 SITE QUALITY CONTROL

- .1 Manufacturer's Site Services: Provide manufacturer's site services consisting of periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave work areas clean, free from grease, finger marks and stains.

3.8 PROTECTION

- .1 Take measures to protect metal panel installations from construction activities for duration of Project. Do not permit activities that may result in gouging, scratching or denting metal panels, trim or flashings.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 07 21 13 - Board Insulation
- .2 Section 07 27 00 - Air Barriers and Waterproofing
- .3 Section 07 62 00 - Sheet Metal Flashing and Trim
- .4 Section 07 92 00 - Joint Sealants

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME B18.6.3-2024, Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series)
- .2 ASTM International (ASTM):
 - .1 ASTM A653/A653M-18, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 ASTM F1667-18a, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples
- .3 European Committee for Standardization (CEN):
 - .1 EN 15804:2012+A2:2019, Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products
- .4 CSA Group (CSA):
 - .1 CSA B111-1974, Wire Nails, Spikes and Staples
 - .2 CSA Z809:16, Sustainable forest management
- .5 Forest Stewardship Council (FSC):
 - .1 FSC-STD-01-001-[v5-3], FSC Principles and Criteria for Forest Stewardship
- .6 International Organization for Standardization (ISO):
 - .1 ISO 14025:2006, Environmental labels and declarations — Type III environmental declarations — Principles and procedures
 - .2 ISO 14040:2006, Environmental management — Life cycle assessment — Principles and framework
 - .3 ISO 14044:2006, Environmental management — Life cycle assessment — Requirements and guidelines
 - .4 ISO 14067:2018, Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification
 - .5 ISO 21930:2017, Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services
- .7 ULC Standards (ULC):
 - .1 CAN/ULC-S706.1:2016, Standard for Wood Fibre Insulating Boards for Buildings

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by the Consultant and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review installation and substrate conditions.
 - .4 Coordination with other Subcontractors.
 - .5 Review manufacturer's instructions and warranty requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: Product literature and data sheets for steel siding, including product characteristics, performance criteria, physical sizes, finishes, and limitations.
- .3 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Show location of each component, dimensioned plans and elevations, large scale details, trim and closure pieces, and attachment details.
- .4 Samples:
 - .1 Samples for initial selection: Representing manufacturer's standard range of available colours, patterns, textures, and finishes.
 - .1 Submit samples for:
 - .1 steel siding
 - .2 each type of exposed trim
 - .3 each type of exposed flashing
- .5 Manufacturer's instructions:
 - .1 Special delivery, storage, and handling requirements.
 - .2 Installation instructions.
 - .3 Recommended sequencing.
 - .4 Cleaning procedures.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance data:
 - .1 Include, in the operation and maintenance manual, manufacturer's maintenance instructions and recommended cleaning materials and methods.

1.6 QUALITY ASSURANCE

- .1 Mock-ups: Erect in accordance with Section 01 43 00 - Quality Assurance.
 - .1 Erect part of one exterior wall, including the entire assembly (sheathing, air barrier, exterior insulation, furring, flashings, closures, trim, and steel siding).
 - .2 Minimum size: 3m wide × 3m high.
 - .3 Location: Acceptable to the Consultant.
 - .4 Acceptable mock-ups may not remain as part of the work.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements, and:
 - .1 Deliver and store cartons flat and supported along entire length.
 - .2 Store materials off ground, out of weather, in dry place. Provide ventilation. Protect from falling objects and construction activities.

PART 2 PRODUCTS

2.1 STEEL SIDING

- .1 Sheet steel: To ASTM A653/A653M, commercial steel (CS), Type A, Grade 230, Z275 coating designation applied to both sides, with preformed interlocking joints.
 - .1 Base metal thickness: 0.76 mm minimum.
 - .2 Surface texture: Smooth
- .2 Profile:
 - .1 MC-4:
 - .1 Shape: Flat Panel with Tongue and Groove joint.
 - .2 Height: 300 mm nominal.
 - .3 Depth: 38 mm.
 - .4 Reveal: Non Applicable
 - .5 Basis of Design:
 - .1 Ideal Roofing, Model: Urban Accent UA-1200
 - .2 VicWest, Model: AD300
 - .3 Agway, Model HF-12NF
 - .2 MC-5:
 - .1 Shape: Flat Panel with Tongue and Groove joint.
 - .2 Height: 300 mm nominal.
 - .3 Depth: 38 mm.
 - .4 Reveal: 25mm
 - .5 Basis of Design:
 - .1 Ideal Roofing, Model: Urban Accent UA-1101
 - .2 VicWest, Model: AD275
 - .3 Agway, Model HF-11NF
- .3 Sustainability characteristics:
 - .1 Recycled content: Minimum 20% post-consumer and pre-consumer.
- .4 Performance/design criteria:
 - .1 Fastening system: Concealed.
 - .2 Installation orientation: As indicated on Drawings.
- .5 Finishes:
 - .1 Finish coating: Factory precoat with modified silicone paint finish, two-coat system, minimum 25µm dry film thickness.
 - .2 Gloss level: As selected by the Consultant from manufacturer's samples.
 - .3 Colour: As selected by the Consultant from manufacturer's samples.
 - .4 Number of colours: Three.

2.2 STEEL FLASHING AND TRIM

- .1 Sheet steel: To ASTM A653/A653M, commercial steel (CS) with Z275 zinc coating on both sides.
 - .1 Base metal thickness: .759] mm minimum.
- .2 Profiles: Manufacturers Standard.
- .3 Sustainability characteristics:
 - .1 Recycled content: Minimum 20% post-consumer and pre-consumer.
- .4 Finishes:
 - .1 Finish coating: Factory precoated with modified silicone paint finish, two-coat system, minimum 25µm dry film thickness.
 - .2 Gloss level: As selected by Consultant from manufacturer's samples.
 - .3 Colour: As selected by the Consultant from manufacturer's samples.
 - .1 Number of colours: Two.

2.3 ACCESSORIES

- .1 Fasteners:
 - .1 Nails: To ASTM F1667, purpose made.
 - .2 Screws: To ASME B18.6.3, purpose made.
 - .3 Material: Galvanized steel.
 - .4 Minimum length: 38 mm.
- .2 Exposed flashing and trim: Inside corners, outside corners, cap strips, drip caps, undersill trim, starter strips, and window/door trim as indicated on Drawings and in accordance with Section 07 62 00 - Sheet Metal Flashing and Trim.
- .3 Sealants: In accordance with Section 07 92 00 - Joint Sealants.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .2 Verify the Consultant has reviewed substrates to be concealed by work of this section and remedial work is complete and acceptable.
 - .3 Verify air barriers are installed in accordance with [Section 07 27 00 – Air Barriers and Waterproofing
 - .4 Verify continuous exterior insulation is installed in accordance with Section 07 21 13 - Board Insulation.
 - .5 Verify mounting blocks are installed for wall-mounted handrails, doorbells, vents, light fixtures, utility connections, and similar exterior fixtures.

3.2 PREPARATION

- .1 Surface preparation:
 - .1 Prepare surfaces in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Furr surfaces to even plane and free from obstructions.

3.3 INSTALLATION

- .1 Install steel siding true to line and in accordance with manufacturer's instructions and reviewed shop drawings.
 - .1 Fastener spacing: As recommended by steel siding manufacturer, but maximum 600mm on-centre.
 - .2 Attach components in manner not restricting thermal movement.
 - .3 Overlap end joints to shed water from direction of prevailing wind. Overlap distance in accordance with manufacturer's recommendations.
- .2 Install continuous starter strips, inside and outside corners, edgings, drip flashings, cap flashings, sill flashings, and flashings at openings in accordance with Section 07 62 00 - Sheet Metal Flashing and Trim.
- .3 Install outside corners, fillers and closure strips with carefully formed and profiled work.
- .4 Apply sealant at junctions with adjoining work in accordance with Section 07 92 00 - Joint Sealants.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning.
- .2 Waste management:
 - .1 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal.

3.5 PROTECTION

- .1 Protect partially installed and completed work from damage.

OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Latex modified concrete facing, bonded to rigid polystyrene foam insulation backing, for exterior application to low rise, and perimeter foundation walls, with related flashings and accessory components.
- .2 Above and below grade locations: Suitable air/vapour barriers site specific, as required over structural walls.

1.2 RELATED SECTIONS

- .1 Section 07 27 00 - Air Barriers and Waterproofing.
- .2 Section 07 62 00 - Sheet Metal Flashing And Trim.
- .3 Section 07 84 00 - Firestopping.

1.3 REFERENCES

- .1 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701, Standard for Thermal Insulations, Polystyrene, Boards and Pipe Covering.
 - .2 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A123/A123M, Zinc (Hot Dip Galvanized) Coatings on Iron or Steel Products.
 - .2 ASTM C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - .3 ASTM D1621, Standard Test Method for Compressive Properties Of Rigid Cellular Plastics.
 - .4 ASTM D2842, Standard Test Method for Water Absorption of Rigid Cellular Plastics.
 - .5 ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials.
 - .6 ASTM D696, Standard Test Method for Determining Coefficient of Linear Thermal Expansion of Plastics between -30C and +30C.
 - .7 ASTM C203, Standard Test Method for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
 - .8 ASTM D2126, Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
- .3 Canadian Standards Association
 - .1 CSA S478-95 (R2007) – Guideline on Durability in Buildings.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Submit current copy of the Safety Data Sheet (SDS)

1.4 SYSTEM DESCRIPTION

- .1 Assembly of components includes purpose supplied, preformed panel mounting clips capable of securing factory bonded concrete faced insulated wall panels to structural supporting wall framing.
- .2 Comply with requirements for continuity of building air barriers, vapour retarders plus wind and suction loads as identified in the National Building Code and applicable local requirements.

1.5 PERFORMANCE REQUIREMENTS

- .1 Wall assembly: Design components to withstand flexing and physical distortion due to dead and live loads caused by positive and negative wind pressure acting normal to plane of wall cladding surfaces.
- .2 Maximum Allowable Deflection of Wall Assembly: Determined by supporting structure and imposed weather loads.
- .3 Movement: Accommodate thermal and wind loads within wall assembly without damage to components or deterioration of seals, movement within assembly and between components, when subject to seasonal temperature cycling; dynamic loading and release of loads; deflection of structural support framing.
- .4 Maximum Allowable Deflection of Wall Assembly: 1/280 of span.
- .5 Drainage: Provide positive drainage to water and condensate collectors within wall assembly.
- .6 Products: Provide continuity of thermal barrier at building enclosure elements in conjunction with other thermal insulating materials.
- .7 Vapour Retarder: Provide continuity of vapour retarder at building enclosure elements in conjunction with vapour retarders specified in Section 07 26 00.
- .8 Air Seal: Provide continuity of air barrier seal at building enclosure elements in conjunction with air seal materials specified in Section 07 27 00.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the Work for installation of vapour retarder and air barrier seals.
 - .3 Coordinate the Work with installation of windows, louvres, and components or materials

1.7 SUBMITTALS FOR REVIEW

- .1 Submission procedures as specified in Section 01 33 00.
- .2 Shop Drawings: Indicate dimensions, layout, construction and expansion joints, construction details, methods of anchorage.
- .3 Samples: Submit two (2) samples of full size wall siding, 200 x 200 mm (8 x 8 inch) in size illustrating manner of fitment devices with adjacent panels, with specified finishes and surface texture.

1.8 SUBMITTALS FOR INFORMATION

- .1 Submission procedures as specified in Section 01 33 00.
- .2 Installation Data: Manufacturer's special installation requirements.

1.9 SUSTAINABILITY

- .1 Minimal Packaging
- .2 Materials and manufacturing within 800 km (500 mile) radius by truck or 2400 km (1500 mile) radius by rail of the project site. (Confirm locations with manufacturer.)

- .3 Manufacturing process includes a comprehensive recycling program.

1.10 QUALITY ASSURANCE

- .1 Installer Qualifications: Company specializing in performing the work of this section with training and experience.
- .2 Product Identification: Each pallet of insulated roof panels shall be labelled with product name; manufacturers name or trademark; insulation conforming to ULC S701 Type 4; number of panels per pallet; insulation thickness, and thermal resistance per unit of thickness.
- .3 Insulation must conform to CCMC – Evaluation Listing #04888-L, for NBC compliance.

1.11 MOCK-UP

- .1 Requirements for mock-up as specified in Section 01 45 00.
- .2 Provide 1 m (3 feet) long by 1 m (3 feet) wide mock-up, which includes structural supports for siding [and soffit] components, panels, attachments to building frame, associated vapour retarder and air seal materials, weep drainage system, sealants and seals, and related insulation.
- .3 Locate where directed by Consultant.
- .4 Approved mock-up may not remain as part of the Work.

1.12 DELIVERY, STORAGE, AND PROTECTION

- .1 Transport, handle, store, and protect delivered products as specified in Section 01 61 00.
- .2 Store concrete faced insulated wall panels under cover, and in original packaging until ready to install. Store opened packages under cover until installed. Schedule installation to minimize open package time
- .3 Store prefinished material off ground protected from weather, to prevent twisting, bending, or abrasion, and to provide ventilation.
- .4 Prevent contact with materials which may cause electrolysis, discolouration or staining.

1.13 WARRANTY

- .1 Provide warranties as specified in Section 01 78 00: Closeout Procedures.
- .2 Provide manufacturers five (5) year limited warranty to include panel replacement for delamination of concrete facing.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- .1 This specification is based on 'Tech-Crete Processors Ltd, CFI Wall Panels'
- .2 Requests for substitutions will be considered in accordance with provisions of Section 01 25 00 "Substitution Procedures". Acceptance of alternative products is subject to the approval of the Consultant.

2.2 WALL PANEL ATTACHMENT

- .1 Galvanized Steel: ASTM A123/A123M-08 - Zinc-Coated (Galvanized), Z275 to G90 coating designation, preformed as supplied by manufacturer, complete with corrosion proof masonry fasteners.

2.3 INSULATION

- .1 STYROFOAM™ Tech-Crete Blanks by DOW Chemical, extruded polystyrene, conforming to code requirements, in accordance with CAN/ULC S701 type 4.
 - .1 Thermal resistance: RSI 0.87/25mm to ASTM C518.
 - .2 Foam Compressive Strength: 240 kPa (35 PSI) in accordance with ASTM D1621.
 - .3 Water Absorption: ASTM D2842: <0.7 % by volume.
 - .4 Water Vapour Permeance: 0.8 perms in accordance with ASTM E96.
 - .5 Insulation Thickness: 102 mm (4 inches).

2.4 CONCRETE FACED INSULATED WALL PANELS

- .1 Concrete: Latex modified concrete mix, 8 mm (5/16") thick, with control joint score at mid-length.
- .2 Edge Treatment: Tongue and groove along longitudinal foam edges, butt joints on lateral edges.
- .3 Surface Finish: Textured Broom finish; Grey colour, may be coated.

2.5 ACCESSORIES

- .1 Gaskets to Adjacent Substrates: Standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant; colour to match adjacent colour.
- .2 Sealants to Adjacent Substrates: Standard type suitable for use with installation of system; non-staining, non-skinning, non-shrinking and non-sagging; ultraviolet and ozone resistant; colour as selected.
- .3 Clips and Fasteners: Manufacturer's standard type to suit application; as supplied.
- .4 Field Repair and Touch-up: As recommended by panel manufacturer.
- .5 Wall panel coloured coating (if required): Exterior grade, latex based, concrete or masonry paint or stain.
- .6 Perimeter Insulation Flashings 24 gauge minimum: Coordinate supply of end closures and flashings for perimeter insulation system with Section 07 62 00.

2.6 COMPONENTS

- .1 Exterior concrete faced insulated wall panel sizes:
 - .1 Width: 610 mm (24 inches).
 - .2 Length: 1220 mm (48 inches).
 - .3 Thickness: 100 mm (4 inches)
- .2 Internal and External Corners:
 - .1 Manufacturers installation guidelines provide corner details. Diagrams are also provided in each fastener package.
 - .2 Metal profiles to suit assembly, brake formed to required profiles
 - .3 Trim, Closure Pieces, Caps, Flashings, Facias, Soffits and Infills: Brake formed to required profiles.

2.7 FABRICATION

- .1 Form sections true to shape, accurate in size, square, and free from distortion or defects.
- .2 Form custom pieces in longest practicable lengths.
- .3 Fabricate corners in one continuous piece.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verify existing conditions and substrates before starting work as specified in Section 01 71 00.
- .2 Verify that building framing members are ready to receive panel assembly.
- .3 Remove substrate surface irregularities before installing wall panels. Sweep and clear debris clear of surfaces to receive panels.
- .4 Ensure existing [damp proofing] [water proofing] below grade is cured and dry.
- .5 If the lowest substrate surface is not level to receive panels, create a level surface with a galvanized steel ledger angle, and secure level.

3.2 INSTALLATION

- .1 Install one (1) layer damproofing horizontally on walls to receive concrete faced insulated wall panels.
- .2 Weather lap barriers, stagger vertical joints of each course. Repair incidental tears.
- .3 Seal securely to achieve air and moisture tightness.
- .4 Ensure snug fit between panel tongue and grooves, and lateral butt joints.
- .5 Fasten concrete faced insulated panels to structural supports; aligned level and plumb.
- .6 Install panels with vertical joints and panel control joints in alignment.
- .7 Use manufacturer's fasteners. Maintain neat appearance.
- .8 Cover exposed insulation at corners and top of perimeter insulation with prefinished flashing as specified in Section 07 62 00.
- .9 Where concrete flatwork or asphalt is to be laid adjacent to CFI Wall Panels, an isolation joint should be provided to protect the CFI mortar surface from differential movement

3.3 CLEANING

- .1 Clean installed work as specified in Section 01 74 11 - Cleaning.
- .2 Remove and collect site cuttings, foam bits and packaging for re-cycling.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 Section 07 62 00 – Sheet Metal Flashing and Trim
- .2 Section 07 92 00 – Joint Sealants

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA A123.4-04, Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.
- .2 ASTM International Inc.
 - .1 ASTM C578-01, Standard Specification for Rigid Cellular Polystyrene Thermal Insulation.
 - .2 ASTM C 726-05, Standard Specification for Mineral Fiber Roof Insulation Board.
 - .3 ASTM D 41-05, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 - .4 ASTM D 6162-00a, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements.
 - .5 ASTM D 6163-00e1, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fibre Reinforcements.
 - .6 ASTM D 6164-05, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
- .3 Canadian General Standards Board (CGSB)
 - .1 Prefabricated membrane, complies with CAN/CGSB 37-GP-56M (9th draft)-1985, Membrane Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
- .4 Canadian Roofing Contractors Association (CRCA)
 - .1 CRCA Roofing Specifications Manual.
- .5 Underwriters Laboratories' of Canada (ULC)
 - .1 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .2 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.3 COMPATIBILITY

- .1 All waterproofing materials will be provided by the same manufacturer.

1.4 QUALITY ASSURANCE AND ENVIRONMENTAL MANAGEMENT

- .1 The manufacturer of elastomeric bitumen products will provide proof of ISO 9001 and ISO 14001 Certifications.

1.5 CONTRACTOR QUALIFICATIONS

- .1 Roofing contractors and sub-contractors must, when tendering or performing work, possess a roofing contractor operating license.

- .2 The work of this Section shall be carried out by a Roofing Contractor who is certified by the roofing material manufacturer, as an approved installer and who is a member in good standing of the CRCA or the applicable affiliated provincial roofing contractors' association.
- .3 Roofing work shall be performed only by skilled applicators, employed by a company operating all adequate and necessary equipment required to execute such work.

1.6 MANUFACTURER'S REPRESENTATIVE

- .1 The work shall be carried out under the general supervision of a representative of the roofing material manufacturer.
- .2 At all times, the Roofing Contractor shall permit and facilitate access to the work site by the said manufacturer's representative.

1.7 INSPECTION

- .1 Roofing installation inspection will be done by the roof consultant chosen by the owner.
- .2 All inspection fees will be paid by the owner.
- .3 Cooperate fully with the roof consultant.

1.8 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit a report, issued by a certified material testing laboratory, attesting that the roofing system offered, was tested in accordance with CSA A 123.21-04, Standard Test Method for Dynamic Wind Uplift Resistance of Mechanically Attached Membrane Roofing Systems. Test results shall demonstrate the roofing system sustained wind uplift pressures of -0.7 kPa for the field of the roof, -1.1 kPa for the edge of the roof, and -1.7 kPa for the corners of the roof. The edge and corner area are defined as 2m from each edge of the roof.
- .2 Submit a document issued by the CSA certifying that the roofing system offered meets the requirements of CAN/ULC-S107-03 "Standard Methods of Fire Tests of Roof Coverings Class C.
- .3 Provide submittals in accordance with Section 01 00 10 – General Instructions.
- .4 Product Data:
 - .1 Provide two copies of most recent technical waterproofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide two copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements, and indicate VOC content for:
 - .1 Primers.
 - .2 Asphalt.
 - .3 Sealers.
 - .4 Filter fabric.
- .5 Provide shop drawings and indicate:
 - .1 Flashing, control joints, tapered insulation details.
 - .2 Layout and roof slopes for tapered insulation.

- .6 Product Certification: Notarized certificate, signed by the roofing system manufacture, indicating that products to be provided and the completed roofing system meet the requirements of the Contract Documents. Submit the following as attachments:
 - .1 Test and Evaluation Reports: submit laboratory test reports certifying compliance of bitumen's and membrane with specification requirements.
 - .2 Evidence of compliance with performance requirements.
 - .3 Statement indicating that the proposed system components are compatible with each other and with adjacent construction.
- .7 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.
- .8 Manufacturer's field report: in accordance with Section 01 00 10 – General Instructions.
- .9 Reports: indicate procedures followed, ambient temperatures and wind velocity during application. Submit to consultant within 3 days of date.

1.9 ADMINISTRATIVE REQUIREMENTS

- .1 Convene a pre-installation meeting prior to start of waterproofing works, with the roofing contractor's representative, the architect, and the owner. The purposes of this meeting is to review installation conditions particular to this project
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building sub-trades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.10 DELIVERY, STORAGE, AND HANDLING

- .1 All materials will be delivered and stored in conformance with the requirements recommended by the manufacturer; they must remain in their original packaging, displaying the manufacturer's name, product name, weight, and reference standards, as well as all other indications or references considered standard.
- .2 At all times, materials will be adequately protected and stored in a dry and properly ventilated area, away from any welding flame or spark and sheltered from the elements or any harmful substance. Only materials destined for same-day use can be removed from this storage area. In cold weather, these materials should be stored in a heated area at a minimum temperature of +10°C and removed prior to application. If rolls cannot be stored in a heated environment, they may be pre-conditioned before installation. For precise description, please consult SOPREMA'S "Roofers' Guide" on membrane application procedures.
- .3 Store adhesives and emulsion-based waterproofing mastics at a minimum +5°C. Store adhesives and solvent-based mastics at sufficient temperatures to ensure ease of application.
- .4 Materials delivered in rolls will be carefully stored upright; flashing will be stored to avoid creasing, buckling, scratches or any other possible damage.
- .5 Avoid material overloads which may affect the structural integrity of specific roof areas.
- .6 Handle waterproofing materials in accordance with manufacturer's written directives, to prevent damage or loss of performance.

- .7 Store and manage hazardous materials in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.11 FIRE PROTECTION

- .1 Prior to the start of work, conduct a site inspection to establish safe working practices and make sure that all procedures and proposed changes are approved to minimize the risk of fires.
- .2 Respect safety measures described in the manufacturer's Specifications Manual as well as local association recommendations.
- .3 At the end of each workday, use a heat detector gun to spot any smouldering or concealed fire. Job planning must be organized to ensure workers are still on location at least one hour after torch application.
- .4 Never apply the torch directly to old and wood surfaces.
- .5 Throughout roofing installation, maintain a clean site and have one approved ABC fire extinguisher within 6 metres of each roofing torch. Respect all safety measures described in technical data sheets. Torches must never be placed near combustible or flammable products. Torches should never be used where the flame is not visible or cannot be easily controlled.
- .6 Use only self-igniting and self-extinguishing torches for the SBS Membrane installations.

1.12 SITE CONDITIONS

- .1 Ambient Conditions
 - .1 Do not install waterproofing when temperature remains below -18 degrees C for torch application, or -5 degrees C to manufacturers' recommendations for mop application.
 - .2 Minimum temperature for solvent-based adhesive is -5 degrees C.
- .2 Install waterproofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into waterproofing system.

1.13 WARRANTY

- .1 Membrane manufacturer's warranty: In addition to the 12 months warranty prescribed by General Conditions of the Contract, provide a written warranty, signed and issued in the name of the Owner, stating that the membrane manufacturer will guarantee to repair at his own expense any leaks in the roofing membrane or flashing membrane resulting from defects in the manufacture of the membrane and/or from faulty workmanship for a period of ten (10) years from the date of the Certificate of Substantial Completion.
- .2 Roofing Contractor's warranty: In addition to the 12 months warranty prescribed by the General Conditions of the Contract, provide a written warranty, signed and issued in the name of the Owner, stating that the Roofing Contractor will guarantee to repair at his own expense any leaks in the roofing membrane or flashing membrane resulting from faulty workmanship, in accordance with the General Conditions of the Contract but for a period of five (5) years from the date of the Certificate of Substantial Performance of the Contract

PART 2 PRODUCTS

2.1 GENERAL

- .1 This specification is based on modified bituminous sheet membrane roofing as manufactured by Soprema Inc.
- .2 Subject to compliance with the specification requirements, equivalent products by the following manufacturers are acceptable alternatives:
 - .1 Garland Canada Inc.
 - .2 Henry Co.
- .3 All components of the roofing system shall be obtained from or approved by a single manufacturer.

2.2 VAPOUR BARRIER SUPPORT PANELS

- .1 Fibre-reinforced gypsum roof board to CAN/ULC S102 and ASTM D3273, 1219 mm wide x 2438 mm long x 13 mm thick, ends and edges square.
- .2 Fasteners: Size and type in accordance with FM requirements and the membrane manufacturer's recommendations.

2.3 VAPOUR RETARDER

- .1 Self-adhesive Air/Vapour Barrier:
 - .1 Description: Self-adhesive air/vapour barrier membranes composed of SBS modified bitumen, with surface screen mad of high-density polyethylene laminated between two layers of polyethylene films. The self-adhesive underface is protected with a silicone plastic release film. Water vapour permeability: 0.92 ng/Pa.s.m² (0.016 Perm).
 - .2 Acceptable Product: SOPRAVAP'R

2.4 INSULATION

- .1 Composite Board Insulation: Board composed of SBS modified bitumen membrane with a polyester reinforcement, factory-laminated on a mineral wool board. The membrane measures 1 m x 4.91 m (3.28 ft x 16.10 ft). The surface is sanded.
- .2 Sloped insulation: Factory pre-engineered tapered polyisocyanurate sloped insulation compatible with the roof membrane system. Provide slopes at roof drain areas as required to obtain roof slopes of no less than 1:50 (2%). Including the upslope side of HVAC equipment and other curbs to direct run-off from accumulating behind the units. Standard of Acceptance: Johns Manville, Atlas, Accu-plane, Posi-slope.

2.5 CANT STRIP

- .1 Mineral wool coated with a bitumen and lightly sanded surface conforming to ASTM C726.
 - .1 Physical Properties:
 - .1 Density: 176 kg/m³
 - .2 Compressive Strength: 84 kpa
 - .3 Water Absorption (perm): >30

2.6 MEMBRANE SYSTEMS

- .1 Base sheet: to CGSB 37-GP-56M, polyester fibres to ASTM D6164.
 - .1 Styrene-Butadiene-Styrene (SBS) elastomeric polymer prefabricated sheet, polyester reinforcement, having nominal weight of 100 g/m².
 - .2 Type 1, fully adhered.
 - .3 Class: C-plain surfaced.
 - .4 Grade: 1-standard service.
 - .5 Top and bottom surfaces: Sanded/polyethylene
 - .6 Base sheet membrane properties: to CGSB 37-GP-56M.
 - .1 Strain energy (longitudinal/transversal): 9.0/7.0 kN/m.
 - .2 Breaking strength (longitudinal/transversal): 17.0/12.5 N/5 cm.
 - .3 Ultimate elongation (longitudinal/transversal): 60/65%.
 - .4 Tear resistance: 85 N.
 - .5 Cold bending at -30 degrees C: no cracking.
 - .6 Softening point: 110 degrees C.
 - .7 Static puncture resistance: 300.
 - .8 Dimensional Stability: -0.3 / 0.3%.
 - .7 ULC certification: Class A.
 - .8 Basis of Design: Sopralene-Flam-180
- .2 Base Sheet Membrane for Flashings and Parapets
 - .1 Description: Membrane composed of SBS modified bitumen with a composite reinforcement. The surface is sanded and self-adhesive under face.
 - .1 Styrene-Butadiene-Styrene (SBS) elastomeric polymer prefabricated sheet, glass & polyester reinforcement, having nominal weight of 3.3 kg/m².
 - .1 Type: C.
 - .2 Grade: 3.
 - .2 Top and bottom surfaces:
 - .1 Sanded/Self-Adhesive.
 - .3 Base sheet membrane properties: to [CSA A123.23-15B](#)
 - .1 Strain energy (longitudinal/transversal): Min. 9.0/7.0kN/m.
 - .2 Breaking strength (longitudinal/transversal): Min. 17.0/18.0 N/5 cm.
 - .3 Ultimate elongation (longitudinal/transversal): Min. 60/65%.
 - .4 Tear resistance: Min. 60 N.
 - .5 Cold bending at -30 degrees C: no cracking.
 - .6 Softening point: 3 110 degrees C.
 - .7 Static puncture resistance:> 400.
 - .8 Dimensional Stability: -0.3 / 0.3 %.
- .3 Cap sheet membrane: to CGSB 37-GP-56M, polyester fibres to ASTM D6164.
 - .1 Styrene-Butadiene-Styrene(SBS) elastomeric polymer, prefabricated sheet, polyester reinforcement, having nominal weight of 180 g/m².
 - .2 Type 1, fully adhered.
 - .3 Class: A-granule surfaced.
 - .1 Colour for granular surface: gray.
 - .4 Grade 1-standard service.
 - .5 Bottom surface: polyethylene.
 - .6 Cap sheet membrane properties: to CGSB 37-GP-56M.
 - .1 Strain energy (longitudinal/transversal): 11.0/11.4 kN/m.
 - .2 Breaking strength (longitudinal/transversal): 25.0/16.0 kN/m.
 - .3 Ultimate elongation (longitudinal/transversal): 60/65%.
 - .4 Tear resistance: 80 N.

- .5 Cold bending at-30 degrees C: No cracking.
- .6 Softening point: 110 degrees C.
- .7 Static puncture resistance: 370.
- .8 Dimensional Stability: -0.2 / 0.2%.
- .7 ULC certification: Class A.
- .8 Basis of Design: Sopralene Flam 180GR

2.7 PRIMER

- .1 Primer for Thermofusible Membranes
 - .1 Description: Primer made of bitumen, volatile solvents and adhesive resins. Used as primer to improve the adhesion of thermofusible waterproofing membranes.
 - .1 Acceptable Product: ELASTOCOL 500
- .2 Primer for Self-Adhesive Membranes
 - .1 Description: Primer composed of SBS synthetic rubber, adhesive resins and volatile solvents. Used as primer to improve the adhesion of self-adhesive membranes.
 - .1 Acceptable Product: ELASTOCOL STICK

2.8 ADHESIVES

- .1 Insulation Adhesive
 - .1 Description: Two-component, polyurethane-based adhesive used to adhere SBS-Modified Bitumen Membranes. Can be applied at temperatures as low as -10 degrees C.
 - .2 Acceptable Product: SOPRATACK WINTER by SOPREMA

2.9 FLAME-STOP MEMBRANE

- .1 Description: Self-adhesive membrane composed of a reinforced glass mat and SBS modified bitumen designed to prevent flames from penetrating into empty spaces and openings while installing heat-welded membranes.
 - .1 Acceptable Products: SOPRAGUARD Tape

2.10 COMPLEMENTARY WATERPROOFING PRODUCTS

- .1 Waterproofing mastic:
 - .1 Description: Mastic made of synthetic rubbers, plasticized with bitumen and solvents. Aluminum pigments are added to SOPRAMASTIC ALU to provide greater resistance to U.-V.
 - .2 Acceptable Product: SOPRAMASTIC ALU
- .2 Pitch Pocket Filler
 - .1 Description: Polyurethane pitch pocket system made of pre-fabricated modules of various sizes, with interlocking compounds and solvent-free mastic, composed of two-component urethane and mono-component elastomeric sealant.
 - .2 Specified product: INTERCLIP SYSTEM
- .3 Sealing product
 - .1 Description: Composed of a bitumen/polyurethane waterproofing mono-component and polyester reinforcements. Designed to finish upstands and details. (no-flame installation).
 - .2 Acceptable Product: Alsan Flashing by Soprema

2.11 ACCESSORIES

- .1 Mechanical equipment curbs: Seismic type specifically designed to support mechanical equipment on SBS modified bitumen roofs. Size and configuration to suit application.
- .2 Individual equipment supports: Heavy-duty aluminum or steel post and base, seamless spun-aluminum sleeve, fully insulated. Type and size to suit specific application. Standard of acceptance: Lexcor Flash-Tite to suit application.
- .3 Roof drains: Refer to Division 22 "Plumbing".

PART 3 EXECUTION

3.1 SURFACE EXAMINATION AND PREPARATION

- .1 Surface examination and preparation must be completed in conformance with instructions in the membrane manufacturer's technical documentation.
- .2 Before roofing work begins, the owner's representative and roofing foreman will inspect and approve deck conditions (including slopes and wood blocking) as well as upstands and parapets, construction joints, roof drains, plumbing vents, ventilation outlets and others. If necessary, a non-conformity notice will be issued to the contractor so that required corrections can be made. The start of roofing work will mean roofing conditions are acceptable for work completion.
- .3 Do not begin any work before surfaces are smooth, dry, and free of ice and debris. Use of calcium or salt is forbidden for ice or snow removal.
- .4 Be sure plumbing, carpentry and all other work has been duly completed.
- .5 No materials will be installed during rain or snowfall.

3.2 METHOD OF INSTALLATION

- .1 Prepare surfaces and complete waterproofing work in conformance with manufacturer's instructions and recommendations.
- .2 Install roofing elements on clean and dry surfaces, in conformance with manufacturer's instructions and recommendations.
- .3 Roofing work must be completed in a continuous fashion as surfaces are readied and weather conditions permit.
- .4 It is preferable to seal all seams that are not covered by a cap sheet membrane in the same day. The cap sheet cannot be installed if any moisture is present at/in the base sheet seams.
- .5 Whenever membranes are torch-applied, a continuous and even bead of molten bitumen must be visible as the membrane is unrolled and torched.
- .6 Ensure waterproofing conditions for roofs at all times, including protection during installation work by other trades and progressive protection as work is completed (e.g. vents, drains, etc.).
- .7 Complete all work (temporary supports for equipment and bases, disconnection and connection of equipment as needed, moving and lifting of bases, etc.) required for waterproofing beneath

equipment and; use qualified trade persons as required. Temporary supports for waterproofing beneath air-conditioning units must be designed to hold supported loads and distribute these loads to avoid structural damage.

3.3 PROTECTION OF IN-PLACE CONDITIONS

- .1 Cover walls, walks, sloped roofs and adjacent work where materials hoisted or used.
- .2 Use warning signs and barriers. Maintain in good order until completion of Work.
- .3 Clean off drips and smears of bituminous material immediately.
- .4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.
- .5 Protect roof from traffic and damage. Comply with precautions deemed necessary by Consultant.
- .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.
- .7 Metal connectors and decking will be treated with rust proofing or galvanization.
- .8 Protect finished work to avoid damage during roof installation and material transportation. Assume full responsibility for any damage.

3.4 CLEANING

- .1 The work site must be routinely cleared of rubbish and other materials which may hinder roof installation, performance, or present a fire hazard.
- .2 Remove bituminous markings from finished surfaces.
- .3 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.
- .4 Repair or replace defaced or disfigured finishes caused by work of this section.

3.5 EQUIPMENT FOR WORK EXECUTION

- .1 Maintain all roofing equipment and tools in good working order.
- .2 Use torches recommended by Soprema or Manufacturer of the roofing products.

3.6 VAPOUR BARRIER SUPPORT PANELS INSTALLATION ON STEEL DECK

- .1 These boards must be adhered by using specified adhesive applied in continuous strips spaced 305 mm (12 in) maximum on the field surface, on the perimeter, and on corners. Cut boards so edges rest on centre of upper ribs. Cut straight lines with adequate tools.
- .2 Where slopes change, boards will be cleanly cut (avoid breaking boards) to acquire deck shape. Place boards perpendicular to deck ribs for continuous support at extremities.
- .3 Board joints will be staggered, in half-lengths, and perfectly butted.

3.7 APPLICATION OF PRIMER

- .1 Roofing substrates of wood, metal, concrete, masonry or gypsum board surfaces will receive a coat of asphalt primer at a rate of 0.3 to 0.5 l/sq m. (none required for factory-painted metals). All surfaces to be primed must be free of rust, dust or any residue that may hinder adherence. Cover primed surfaces with roofing membrane as soon as possible (on the same day for self-adhesive membranes).

3.8 APPLICATION OF SELF-ADHESIVE VAPOUR RETARDER

- .1 Beginning at the bottom of the slope, without adhering the membrane, unroll onto the substrate for alignment. Do not immediately remove the silicone release sheet.
- .2 Align the roll parallel to the corrugations of the steel deck. Make sure the membrane overlaps are supported along their entire length.
- .3 Peel back one end of the silicone release sheet and adhere this part of the membrane to the substrate. Peel back the remaining release sheet at a 45° angle to avoid wrinkles in the membrane.
- .4 If the membrane is not properly aligned, do not try to adjust it. Instead, cut the roll and start again, making sure that it is properly aligned and that it overlaps the end of the misaligned piece by 150 mm.
- .5 Overlap adjacent membranes by 75 mm. Overlap end laps by 150 mm. Stagger end laps by at least 300 mm.
- .6 Seal to all penetrations (plumbing vents, stacks, sleeves, etc.) to achieve the necessary air seal continuity throughout the roof.

3.9 INSULATION INSTALLATION

- .1 Adhere insulation by using specified adhesive applied in continuous strips spaced 305 mm (12 in) on the field surface, on the perimeter, and on corners.
- .2 All vertical joints between level boards and sloped modules of two rows of insulation board will be staggered.
- .3 Install only as much insulation as can be covered in the same day.

3.10 INSTALLATION OF FLAME-STOP MEMBRANES

- .1 Adhere the membrane directly onto an approved substrate by peeling back the silicone release film. Flame stop membrane is designed to prevent flames from penetrating into empty spaces and openings while installing heat-welded membranes.
- .2 Unroll the flame-stop membrane onto the insulation, being careful to overlap adjacent selvages to ensure that the flame will not penetrate the insulation.

3.11 INSTALLATION OF BOARDS

- .1 Mechanically fasten boards with screws and plates for membranes. Mechanical fasteners must be installed in the centre of the membrane side selvedge. Follow instructions of approval reports for location of fasteners.

- .2 All boards must be in perfect connection, without any significant variances in level, and must be completely adhered to the surface.
- .3 Seal end laps by welding a 330mm wide protection strip centered on the joint.
- .4 Avoid the formation of wrinkles, swellings or fishmouths.

3.12 (EXPOSED) CONVENTIONAL MEMBRANE ROOFING (CMR) APPLICATION

- .1 Base Sheet Application (Torch):
 - .1 Unroll and torch base sheet onto substrate taking care not to burn membrane or its reinforcement or substrate.
 - .2 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.
 - .3 Application to be free of blisters, wrinkles and fish mouths.
- .2 Base sheet flashing installation:
 - .1 Apply base sheet flashing when primer coat is dry and in accordance with manufacturer's written instructions.
 - .2 Position pre-cut membrane pieces; peel back 100 mm to 150 mm of silicone release paper to hold the membrane in place at the top of the parapet, then gradually peel back remaining silicone release paper, pressing down on the membrane with aluminium applicator to provide good adhesion and to provide smooth transition between up-stand and field surface; smooth entire membrane surface with a roller for full adhesion.
 - .3 Cut off corners at end laps being covered by next roll.
 - .4 Install a reinforcing gusset in all inside and outside corners.
 - .5 Seal overlaps at the end of each workday.
- .3 Cap Sheet Application (Torch):
 - .1 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.
 - .2 Weld cap sheet onto base sheet with torch recommended by membrane manufacturer. During application, simultaneously melt both designated contact surfaces so a bead of bitumen is apparent as cap sheet unrolls.
 - .3 Avoid overheating. Take care to avoid excessive bitumen bleed out at joints during installation.
 - .4 Lap sheets 75 mm minimum for side laps and [150] mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.
 - .5 Application to be free of blisters, fishmouths and wrinkles.
 - .6 Do membrane application in accordance with manufacturer's recommendations.
- .4 Flashings:
 - .1 Complete installation of flashing base sheet stripping before installing membrane cap sheet.
 - .2 Torch base and cap sheet onto substrate in 1 metre wide strips.
 - .3 Lap flashing base sheet over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof to membrane base sheet minimum 150 mm and seal by mopping or torch welding.
 - .4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.
 - .5 Provide 75 mm minimum side lap and seal.
 - .6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.
 - .7 Do work in accordance with manufacturer's recommendations and Section 07 62 00 – Sheet Metal Flashing and Trim.

- .5 Roof penetrations:
 - .1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with [manufacturer's recommendations and details.

3.13 INSTALLATION OF SELF-ADHESIVE BASE SHEET ON FLASHINGS AND PARAPETS

- .1 Apply base sheet flashing only after primer coat is dry.
- .2 Before applying membranes, always burn the plastic film from the section to be covered if there is an overlap (inside and outside corners and field surface). For sanded base sheet membranes, apply primer for self-adhesive membrane on the area to be covered at the foot of the parapets.
- .3 Cut off corners at end laps of areas to be covered by the next roll.
- .4 Each seldge will overlap the previous one along lines provided for this purpose, and by 150 mm (6 in) at the ends.
- .5 Position the pre-cut membrane. Remove 150 mm (6 in) of the silicone release film to hold the membrane in place at the top of the parapet.
- .6 Then, gradually peel off the remaining silicone release film, pressing down on the membrane with an aluminum applicator to ensure good adhesion. Use the aluminum applicator to ensure a perfect transition between the flashing and the field surface. Smooth the entire membrane surface with a membrane roller for full adhesion.
- .7 Install a reinforcing gusset at all inside and outside corners.
- .8 Always seal overlaps at the end of the workday.
- .9 Avoid the formation of wrinkles, swellings or fishmouths.

3.14 INSTALLATION OF REINFORCED GUSSETS

- .1 Install reinforcing gussets at all inside and outside corners.
- .2 Heat-weld the gussets in place after installing base sheet membrane.

3.15 INSTALLATION OF WELDABLE REINFORCING MEMBRANES

- .1 Install reinforcing membranes specified according to the typical detailed instructions in the documentation of membrane manufacturer.

3.16 INSTALLATION OF ROOF DRAINS

- .1 Coordinate with Division 22 to ensure proper seals to roof drains.
- .2 Burn the plastic film of the section to be covered by the roof drain.
- .3 Insert the drain sleeve into the rainwater drainage opening on the roof.
- .4 Peel off the release protection film and adhere the flexible deck flange to the base sheet membrane of the field surface.
- .5 Apply pressure over the whole surface using a membrane roller.

- .6 Seal the perimeter of the of the flexible deck flange with a torch and a round nosed-trowel.
- .7 Heat-weld the cap sheet membrane on the roof drain flexible deck flange. Allow to cool and cut the roof drain hole.
- .8 Position and centre the strainer at the upper rainwater drainage opening of the roof drain.
- .9 Insert and slide the legs of the strainer into the sleeve of the roof drain. Adjust the legs according to diameter. Tighten the upper screws to fix the legs and tighten the side screws to hold the strainer in place.

3.17 INSTALLATION OF VENT STACKS

- .1 Burn the plastic film of the section to be covered by the roof drain.
- .2 Insert the aluminum vent sleeve over the main plumbing system.
- .3 Peel off the release protection film and adhere the flexible deck flange to the base sheet membrane of the field surface.
- .4 Apply pressure over the whole surface using a membrane roller.
- .5 Seal the perimeter of the of the flexible deck flange with a torch and a round nosed-trowel.
- .6 Insulate the space between the main plumbing vent system and the aluminum vent sleeve.
- .7 Insert and position the adjustable flashing into the aluminum vent sleeve. The adjustable flashing must sit on the main plumbing vent system.
- .8 Heat-weld the cap sheet membrane on the roof drain flexible deck flange. Allow to cool and cut the roof drain hole.
- .9 Install and affix the aluminum rain cap on the aluminum vent sleeve.

3.18 WATERPROOFING FOR VARIOUS DETAILS

- .1 Install waterproofing membranes in conformance with with typical details indicated in technical documentation of the manufacturer.

3.19 CURBS, SLEEPERS AND EQUIPMENT SUPPORTS

- .1 Provide curbs, sleepers and equipment supports as indicated and as required.
- .2 Install seismic-type mechanical equipment curbs in accordance with the manufacturer's instructions. Coordinate with the mechanical subcontractor to ensure a proper interface between the curb and the supported equipment.
 - .1 Install equipment supports where indicated and where required.

3.20 FIELD QUALITY CONTROL

- .1 Inspection:
 - .1 Inspection and testing of Mod-Bit membrane application will be carried out by testing laboratory designated by NRC Representative.
 - .2 NRC Representative will pay for tests

- .2 Flood Testing:
 - .1 Do not conceal waterproofing until inspection and testing are completed to satisfaction of NRC Representative.
 - .2 Temporarily plug drains and dam horizontal surface areas to be tested and flood with water to minimum depth of 80.
 - .3 Maintain flooded depth for 24 hours.
 - .4 If leaks occur repair and retest.
 - .5 Remove water at end of test.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Shop and site-formed accessories and trim fabricated from sheet metal:
 - .1 Flashings
 - .2 Counterflashing systems

1.2 RELATED REQUIREMENTS

- .1 Section 07 46 19 - Steel Siding
- .2 Section 07 52 00 - Modified Bituminous Membrane Roofing
- .3 Section 07 92 00 - Joint Sealants

1.3 REFERENCE STANDARDS

- .1 The Aluminum Association (AA):
 - .1 AA Aluminum Design Manual [2020]
 - .2 AA DAF-45-[2003], Designation System for Aluminum Finishes
- .2 American Society of Mechanical Engineers (ASME):
 - .1 ASME B18.6.3-[2024], Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series)
- .3 ASTM International (ASTM):
 - .1 ASTM A653/A653M-18, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 ASTM A755/A755M-18 Standard Specification for Steel Sheet, Metallic coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
 - .3 ASTM A792/A792M-[10], Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
 - .4 ASTM B209/B209M-21a, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - .5 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants
 - .6 ASTM D523-14, Standard Test Method for Specular Gloss
 - .7 ASTM D1005-95, Standard Test Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers
 - .8 ASTM D4587-23, Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
 - .9 ASTM F1667-18a, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples
- .4 California Air Resources Board (CARB):
 - .1 2007, [Suggested Control Measure \(SCM\) for Architectural Coatings](#)
- .5 Canadian Roofing Contractors Association (CRCA):
 - .1 [CRCA Roofing Reference Manual - Online](#)

- .6 CSA Group (CSA):
 - .1 CSA A123.3-05, Asphalt saturated organic roofing felt
 - .2 CSA A123.22-08, Self-adhering polymer modified bituminous sheet materials used as steep roofing underlayment for ice dam protection
 - .3 CSA B111-1974, Wire Nails, Spikes and Staples
- .7 Canadian Sheet Steel Building Institute (CSSBI):
 - .1 CSSBI S8-2018, Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products
- .8 Environment and Climate Change Canada (ECCC):
 - .1 [Volatile Organic Compound \(VOC\) Concentration Limits for Architectural Coatings Regulations, \(SOR/2009-264\)](#)
- .9 Fenestration & Glazing Industry Alliance (FGIA):
 - .1 AAMA 611-24, Specification for Anodized Architectural Aluminum
 - .2 AAMA 2603-22, Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix)
 - .3 AAMA 2604-22, Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix)
 - .4 AAMA 2605-22, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix)
- .10 Green Seal (GS):
 - .1 GS-11-21, Paints, Coatings, Stains, and Sealers
 - .2 GS-36-13, Adhesives for Commercial Use
- .11 South Coast Air Quality Management District (SCAQMD):
 - .1 SCAQMD Rule 1113-2016, Architectural Coatings
 - .2 SCAQMD Rule 1168-2022, Adhesive and Sealant Applications
- .12 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 Architectural Sheet Metal Manual 2012
- .13 Underwriters' Laboratories Inc. (UL):
 - .1 UL 2761-2011, Standard for Sustainability for Sealants and Caulking Compounds

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with Section 07 52 00 – Modified Bituminous Membrane Roofing for transition and cap flashings.
 - .2 Coordinate with Section 07 62 00 - Steel Siding for continuous starter strips, inside and outside corners, edgings, drip flashings, cap flashings, sill flashings, and flashings at openings.
- .2 Pre-installation meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by the Consultant and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review installation and substrate conditions.
 - .4 Coordinate with other Subcontractors.

- .5 Review manufacturer's instructions and warranty requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: Product literature and data sheets, including product characteristics, performance criteria, physical sizes, finishes, and limitations.
 - .1 Submit product data for:
 - .1 sheet metal material
 - .2 manufactured items
 - .3 sealants
 - .4 accessories
 - .2 Submit WHMIS SDS for:
 - .1 isolation coatings
 - .2 roof cements
 - .3 pourable sealers
 - .4 sealants
 - .5 asphalt primers
 - .6 touch-up paints
- .3 Shop drawings:
 - .1 Submit shop drawings for sheet metal fabrications that differ from those indicated on Drawings.
 - .2 Show sheet metal thicknesses, flashing dimensions, fastenings, anchorage, expansion joints, and other provisions for thermal movement.
- .4 Samples:
 - .1 Samples for initial selection: Representing manufacturer's full range of available colours, patterns, textures, and finishes.
 - .1 Submit samples for sheet metal finishes.

1.6 QUALITY ASSURANCE

- .1 Mock-ups: Erect in accordance with Section 01 43 00 - Quality Assurance.
 - .1 Include flashings in mock-ups as specified for work of other affected sections.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements, and:
 - .1 Handle and store flashing materials to prevent creases, buckles, scratches, or other damage.

1.8 WARRANTY

- .1 Include work of this section in related cladding or roofing warranties.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Galvanized steel sheet: To ASTM A653/A653M, commercial quality, with Z275 designation zinc coating, finished on both sides.
 - .1 Base metal thicknesses: As indicated in FABRICATION in this section.
 - .2 Sustainability characteristics:
 - .1 Recycled content: Minimum 35% post-consumer and pre-consumer.

2.2 FABRICATION

- .1 General:
 - .1 Machine bend sheet metal to indicated profiles. Form profiles square, true, and accurate to size, free from distortion or other defects detrimental to appearance or performance.
 - .2 Fabricate sheet metal building flashings and trim in accordance with SMACNA's Architectural Sheet Metal Manual.
 - .3 Fabricate aluminum flashings and other sheet aluminum work in accordance with AA's Aluminum Design Manual.
 - .4 Base metal thicknesses:
 - .1 Form sheet metal fabrications with minimum base metal thicknesses in accordance with the reference standards listed, as indicated in this section, but not less than:
 - .1 Typical: 0.46 mm.
 - .2 Fabrications with flat areas wider than 300 mm: 0.62 mm.
 - .3 Concealed fastening strips: 0.80 mm.
 - .2 Use the thickest specified material if there is conflict between the preceding requirements.
 - .5 Fabricate straight flashings or trim in maximum [2400] mm lengths, with S-locks to accommodate thermal movement.
 - .6 Form non-expansion but movable joints to accommodate elastomeric sealant in accordance with SMACNA standards.
 - .7 Flashings built into concrete: Form to accommodate minimum 100 mm lap.
 - .8 Fold minimum 13 mm hem to stiffen free edges.
 - .9 Cleats and attachment devices: Form with same material as sheet metal component being anchored or from compatible, corrosion-resistant metal recommended by sheet metal manufacturer.
 - .1 Size as recommended by SMACNA Architectural Sheet Metal Manual manual or sheet metal manufacturer for application but not less than thickness of metal being secured.
 - .10 Isolation coatings:
 - .1 Apply isolation coatings to metal surfaces to be embedded in concrete or mortar.
 - .2 Back paint metal flashings in contact with dissimilar metals or materials with bituminous paint that would result in electrolytic action or corrosion.
 - .11 Finishes:
 - .1 Flashing and trim exposed to view, including roof flashings exposed in window views: Fabricate with prefinished metal sheets, unless indicated otherwise on Drawings.
 - .2 Flashing and trim concealed from view: Fabricate with plain galvanized steel sheet.
- .2 Metal flashings:
 - .1 Flashings, copings, and fascias:
 - .1 Materials: Galvanized steel.
 - .2 Base metal thicknesses: As indicated in MATERIALS in this section.
 - .3 Finishes: Colour to be selected by Consultant from Manufacturers full range.

- .3 Roof flashings:
 - .1 Curbs, walls, and parapets: Form minimum 200 mm high, where possible.
 - .2 Corner or intersection joints:
 - .1 Typical: Flat locked.
 - .2 Exceptions: Standing seams.
 - .1 Locations/applications: As indicated on Drawings.
- .4 Scuppers: Form to sizes and profiles as indicated on [Drawings].
 - .1 Materials: Galvanized steel.
 - .2 Base metal thicknesses: As indicated in MATERIALS in this section.
 - .3 Finishes: Colour to be selected by Consultant from Manufacturers full range.

2.3 FINISHES

- .1 Prefinished steel sheet:
 - .1 Factory applied two-coat polyvinylidene fluoride (PVDF) resin in accordance with ASTM A755/A755M and AAMA 621.
 - .1 Colour finish on [one side, with wash coat on back] [both sides].
 - .2 Specular gloss: To ASTM D523, 15 units $\pm 5\%$.
 - .3 Exposed coating thickness: To ASTM D1005, minimum 20 μ m dry-film thickness.
 - .4 Colours: As selected by the Consultant from manufacturer's samples.

2.4 ACCESSORIES

- .1 Installation accessories: Corrosion-resistant sheet metal clips, straps, anchoring devices, and similar accessory units necessary for installation and compatible with installed materials.
 - .1 Cleats and hook strips: Same material and temper as sheet metal, minimum 50 mm wide, Provide continuous hook strip at outside of parapets.
 - .1 Thickness: Same as secured sheet metal.
- .2 Fasteners:
 - .1 Nails: To ASTM F1667, CSA B111, of same material as sheet metal flat head roofing nails of thickness suitable for installation requirements.
 - .2 Screws: To ASME B18.6.3, of same material as sheet metal, suitable for substrates and materials, with galvanized coating.
 - .3 Fastener lengths as required to penetrate:
 - .1 25 mm to 40 mm into masonry
 - .2 Minimum 32 mm into, or through, wood members
 - .3 Minimum 13 mm into, or through steel members
- .3 Isolation coatings: Alkali-resistant bituminous paint.
 - .1 Sustainability characteristics:
 - .1 VOC and other chemical limits for on-site, wet-applied products: To GS-11.
- .4 Sealants: in accordance with Section 07 92 00 - Joint Sealants, in colour to match flashing finish colour.
 - .1 Sustainability characteristics:
 - .1 VOC and other chemical limits for on-site, wet-applied products: To CARB SCM for Architectural Coatings.
 - .2 Mastic: To CAN/CGSB-37.29 polyisobutylene, non-hardening, non-skinning, non-drying, non-migrating.
 - .3 Elastomeric: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed.

- .5 Touch-up paint: As recommended by prefinished material manufacturer.
- .1 Sustainability characteristics:
 - .1 VOC and other chemical limits for on-site, wet-applied products: To CARB SCM for Architectural Coatings.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation, and:

3.2 GENERAL INSTALLATION REQUIREMENTS

- .1 Install sheet metal work in accordance with cladding and roofing manufacturers' instructions SMACNA Architectural Sheet Metal Manual, and as indicated on Drawings.
- .2 Provide smooth, flat surfaces free of indentations, bumps, oil canning, or twists. Install with edges and bends hard, sharp, and true to line.
- .3 Coordinate work of this section with flashing work of other sections which ties into this work.
- .4 Provide sheet metal flashing and trim to create a rain screen assembly to the completed air membrane and roofing membrane termination details.
- .5 Install sheet metal flashing and trim to accommodate thermal movement, due to changes in ambient and surface temperatures, without buckling, opening of joints, hole elongation, overstressing components, joint sealant failure, connection failure, or other detrimental effects.
 - .1 Provide clips to resist rotation and avoid shear stress due to thermal movements caused by solar heat gain and nighttime sky heat loss.
 - .2 Design temperature ranges:
 - .1 Ambient: 67 °C.
 - .2 Materials: 100 °C.
 - .3 Install fasteners in slots or oversize holes to allow expansion and contraction.
- .6 Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, or fastener disengagement.
- .7 Use concealed fasteners except where acceptable to the Consultant.
- .8 Isolate sheet metal items, with isolation coatings or other compatible products recommended by manufacturers, to prevent corrosion:
 - .1 Apply between dissimilar metals to prevent galvanic corrosion.
 - .2 Apply between sheet metal items and corrosive substrates.
 - .3 Apply between aluminum and concrete or masonry.

3.3 METAL ROOF FLASHING INSTALLATION

- .1 Install roof metal flashings in accordance with the CRCA Roofing Reference Manual.

- .2 Install metal flashings on roof cant edges, sleepers, parapets and caps, wall junctions, roof dividers, curbs, roof control joints, through-roof penetrations and similar, and as otherwise necessary to provide flashing protection to details. Extend flashings down and onto the horizontal portion of roofs unless otherwise directed.
- .3 Bed flashing flanges in thick coats of roofing cement where required for waterproof performance.
- .4 Install prefinished metal fascias to complete edge details. Install as separate piece from flashing.
- .5 Fasten metal base flashing to walls or upstands along top of flashing. Do not secure to cant strip. Form lapped corner joints. Extend rolled edge of base flashing approximately 25 mm on to roof from toe of cant, and rest on top of roof surface.
- .6 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Install metal flashings over flexible roof flashings after roof flashings have been reviewed by the local roofing contractors association's roofing inspector and Consultant.
- .7 Provide underlayment under sheet metal.
 - .1 Secure in place and lap joints minimum 100 mm.
 - .2 Provide self-adhesive membrane to tie into adjacent assemblies.
 - .3 Install a slip sheet of No. 15 building paper and a course of polyethylene underlayment if installing stainless steel or aluminum directly on cementitious or wood substrates.
- .8 Lock end joints and caulk with sealant.
- .9 Install sheet metal drainage items with straps, adhesives, and anchors recommended by SMACNA Architectural Sheet Metal Manual or the item manufacturer. Coordinate roof drain flashing installation with roof drainage system installation.
- .10 Provide flashing sleeves and collars for pipes and conduit extending through the roof where curb-mounted roof penetrations are not required. Solder sleeves to sheet metal extending minimum 150 mm onto surrounding roofs.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning, and:
 - .1 Clean exposed metal surfaces to remove substances that might cause corrosion of metal or deterioration of finishes.
- .2 Waste management:
 - .1 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal,

3.5 PROTECTION

- .1 Protect partially installed and completed work from damage.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 07 52 00 – Modified Bituminous Membrane Roofing

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM A240/A240M-23a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - .2 ASTM A506-16, Standard Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled
 - .3 ASTM A653/A653M-18, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .4 ASTM B209/B209M-21a, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - .5 ASTM B370-22 Standard Specification for Copper Sheet and Strip for Building Construction
- .2 European Committee for Standardization (CEN):
 - .1 EN 15804:2012 +A2:2019, Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products
- .3 Environment and Climate Change Canada (ECCC):
 - .1 [Volatile Organic Compound \(VOC\) Concentration Limits for Architectural Coatings Regulations, SOR/2009-264](#)
 - .2 [Ozone-depleting Substances and Halocarbon Alternatives Regulations, SOR/2016-137](#)
- .4 International Organization for Standardization (ISO):
 - .1 ISO 14025:2006, Environmental labels and declarations — Type III environmental declarations — Principles and procedures
 - .2 ISO 14040:2006, Environmental management — Life cycle assessment — Principles and framework
 - .3 ISO 14044:2006, Environmental management — Life cycle assessment — Requirements and guidelines
 - .4 ISO 21930:2017, Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services
- .5 Labour Program:
 - .1 [Canada Occupational Health and Safety Regulations, SOR/86-304](#)
- .6 ULC Standards (ULC):
 - .1 CAN/ULC-S701.1:2017, Standard for Thermal Insulation, Polystyrene Boards
 - .2 CAN/ULC-S702.1-14, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification
 - .3 CAN/ULC S704.1:2017, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
- .2 Pre-Installation Meetings: Conduct a site meeting in accordance with Section 01 31 19 – Project Meetings and attended by the Consultant, manufacturer's site services representative, and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review installation and substrate conditions.
 - .4 Coordinate with other Subcontractors.
 - .5 Review manufacturer's instructions and warranty requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Product literature and data sheets for roof hatches and roof hatch safety railing systems, including product characteristics, performance criteria, physical sizes, finishes, WHMIS SDSs, example warranty documentation, and limitations.
- .3 Shop Drawings:
 - .1 Signed and sealed by a qualified professional in accordance with Section 01 43 00 – Quality Assurance.
 - .2 Indicate size and description of components, materials, attachment devices, description of frame and finish, and construction details.
- .4 Manufacturer's Instructions:
 - .1 Special delivery, storage, and handling requirements.
 - .2 Installation instructions.
 - .3 Recommended sequencing.
 - .4 Cleaning procedures.
- .5 Manufacturer's Reports:
 - .1 Confirming work of this Section complies with manufacturer's requirements as specified in SITE QUALITY CONTROL in this Section.
 - .2 Submit within 5 Working Days of site visit.

1.5 QUALITY ASSURANCE

- .1 Mock-Ups: Install mock-ups in accordance with Section 01 43 00 – Quality Assurance.
 - .1 Install one roof hatch and roof hatch safety railing system. Indicate installation methods and details, including integration with the vapour retarder to maintain integrity of the building envelope.
 - .2 Locations: Acceptable to Consultant.
 - .3 Acceptable mock-ups may remain as part of the Work.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data:
 - .1 Include, in the operation and maintenance manual, manufacturer's maintenance and operating instructions and recommended cleaning materials and methods for:
 - .1 roof hatches; and
 - .2 roof hatch safety railing systems.

1.7 WARRANTY

- .1 Manufacturer Warranty: Manufacturer's standard warranty document, executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights the Owner may have under the Contract.
 - .1 Manufacturer's warranty period: 5 years minimum.

PART 2 PRODUCTS

2.1 PERFORMANCE/DESIGN CRITERIA

- .1 Provide manufactured roof hatches designed to withstand the following conditions without air leakage, damage to unit, or permanent deformation to seals:
 - .1 Snow load: 2.3 kPa.
 - .2 Wind uplift: 0.77 kPa.
 - .3 Thermal transmittance: 1.3 W/(m² · K) maximum, exclusive of stiffeners or edge construction.
- .2 Single-Source Responsibility: Obtain each type roof hatch [and roof hatch safety railing system] from a single manufacturer, or by manufacturers approved by the system manufacturer as compatible with other system components. Include all Products required to meet warranty requirements.

2.2 ROOF HATCHES

- .1 Description: Factory-fabricated, thermally-broken roof hatches with insulated double-walled covers and insulated double-walled curb frames, [integral deck mounting flanges,] cover frame counter flashings, sealed corner joints, continuous weathertight perimeter gasketing and hardware.
 - .1 Cover configuration: Single-leaf.
 - .2 Sizes: Provide clear opening dimensions of 750mm x 900mm
 - .3 Curb height: As indicated on Drawings.
 - .4 Materials:
 - .1 Zinc-Coated Steel: To ASTM A653/A653M, commercial steel (CS), with Z275 coating designation.
 - .1 Base metal thickness: To suit design/performance criteria, minimum 2.0 mm nominal.
 - .2 Surface pattern: Minimized spangle.
 - .3 Chemical treatment: Mill phosphated for site-applied paint finish.
 - .4 Recycled Content: Post-consumer plus one-half pre-consumer, 10% minimum.
 - .5 Finishes: Factory-applied powder coating.
 - .1 Exterior Colour: As selected by the Consultant from manufacturer's standard colour range.
 - .2 Interior Colour: As selected by the Consultant] from manufacturer's standard colour range.
- .2 Insulation:

- .1 Regulatory requirements:
 - .1 Blowing agents: GWP less than 150.
 - .2 Material: Contains no CFC, HCFC, or HFC listed in Table 4, Schedule 1 of SOR/2016-137.
- .2 Fibreglass: To CAN/ULC-S702.1, Type 1.
 - .1 Thickness: To suit DESIGN/PERFORMANCE CRITERIA, minimum 50 mm.
- .3 Mineral fibre: To CAN/ULC-S702.1, Type 1.
- .4 Polyisocyanurate: To CAN/ULC-S704.1, rigid closed-cell foam core laminated to non-asphaltic fibreglass-reinforced facers.
 - .1 Type: Manufacturer's standard.
 - .2 Class: 1.
 - .3 Thickness: To suit design/performance criteria, minimum 50 mm.
- .5 Hardware:
 - .1 Material: Galvanized steel or stainless steel.
 - .2 Latches: One-point automatic latching mechanism with interior and exterior turn handles.
 - .3 Lift assistance system: Gas spring with integrated damper, counter-balanced for one-hand operation or compression spring operators enclosed in telescopic tubes.
 - .4 Automatic hold open device: Provide rigid hold-open arms with slip-resistant grip handle to automatically hold covers in open position and permit easy release for closing.
 - .5 Hinge system: Manufacturer's standard butt-or pintle-type.
 - .6 Padlock hasps: Inside.
- .6 Fabrication:
 - .1 Fabricate components free of twists, bends, or visual distortion.
 - .2 Fabricate corners and joints to provide a continuous weathertight seal.
 - .3 Design flashings or extrusions to collect and lead off accumulated moisture.
 - .4 Bolt cover hardware into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

2.3 ROOF HATCH SAFETY RAILING SYSTEMS

- .1 Description: Factory-fabricated fixed roof hatch safety railing system designed for attachment to roof hatch framing without affecting the water resistance of the roof hatch. Provide with hinged gate with self-closing gate hinge and positive latching system.
 - .1 Regulatory Requirements: In accordance with SOR/86-304.
 - .2 Provide manufactured safety railing system and gate:
 - .1 Height: 900 to 1100 mm.
 - .2 Provide intermediate horizontal rail.
 - .3 Supporting posts 3.0 m on centre maximum.
- .2 Performance/Design Criteria: Design railing systems to withstand a static load of 890 N, applied in any direction, at any point on the top rail.
- .3 Components:
 - .1 Posts and rails: Minimum 32 mm diameter Schedule 40 pipe.
 - .2 Hardware:
 - .1 Mounting brackets: 9 mm extruded aluminum.
 - .2 Pivoting post guides: With compression fittings and cast aluminum or stainless steel latching mechanism.
 - .3 Self-closing hinges: Stainless steel.
 - .4 Fasteners: Stainless Steel.
- .4 Fabrication:

- .1 Fabricate roof hatch safety rail systems square, true, and accurate. Deburr cut edges. Accurately fit and secure joints.
- .2 Provide weep holes or another means to drain entrapped water in hollow railings.
- .3 Fabricate joints weathertight.
- .4 Close exposed ends of handrail and railing members with prefabricated end fittings.
- .5 Finishes: Factory-applied powder coating.
 - .1 Colour: High-visibility safety yellow.

2.4 ACCESSORIES

- .1 Gaskets: Manufacturer's standard, with full recovery after 50% compression.
- .2 Fasteners: Manufacturer's standard, corrosion-resistant.
- .3 Isolation Coating: Alkali-resistant bituminous paint or epoxy solution.
 - .1 VOC Limits: In accordance with SOR/2009-264.
- .4 Ladder Safety Post: Telescoping post permanently mounted to the top two rungs of a fixed ladder to provide a positive hand-hold and enable the user to enter or exit the roof hatch in an upright, balanced position.
 - .1 Posts: High strength steel, tubing with a pull up loop at the upper end to facilitate raising the post.
 - .2 Mounting brackets: Adjustable mounting brackets to fit ladder rung spacing up to 356 mm on-centre and clamp brackets to accommodate ladder rungs up to 44 mm in diameter.
 - .3 Mounting hardware: Type 316 stainless steel.
 - .4 Operation: Corrosion-resistant spring balancing mechanism to provide smooth, easy, controlled operation when raising and lowering the ladder safety post. Lock post when fully extended. Provide release mechanism to the post to allow it to be returned to its lowered position.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Erect components plumb, level, and in proper alignment in accordance with manufacturer's instructions [and reviewed Shop Drawings].
- .2 Apply isolation coatings to prevent contact between dissimilar metals.
- .3 Flash and detail installation to maintain integrity of the building envelope.
- .4 Test units for proper function and adjust until proper operation is achieved.
- .5 Repair finishes damaged during installation to the satisfaction of the Consultant.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM E605/E605M-19, Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
 - .2 ASTM E736/E736M-17, Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
 - .3 ASTM E859/E859M-93, Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural Members
 - .4 ASTM G21-15, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)
- .3 ULC Standards (ULC):
 - .1 CAN/ULC-S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .3 ULC List of Equipment and Materials

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings: Hold meeting one week before beginning Work of this Section with the Contractor, Subcontractor and Consultant in accordance with Section 01 31 19 – Project Meetings to
 - .1 verify Project requirements,
 - .2 review site conditions and substrate conditions,
 - .3 coordinate with other Subcontractors, and
 - .4 review manufacturer's application instructions and warranty requirements.
- .2 Before start of work, arrange a site visit with Consultant to examine the existing site conditions adjacent to demolition work.
- .3 Coordination:
 - .1 Coordinate with Subcontractor's responsible for steel and concrete surfaces to ensure accordance with manufacturer's minimum surface preparation requirements for bond surface being free from wax, grease, incompatible primer, or other deleterious materials that could affect bond of materials specified in this Section.
 - .2 Coordinate installation of hangers, inserts, clips and similar items to surfaces needing protection before applying sprayed fire-resistive materials.
 - .3 Prohibit all roof traffic until application of fireproofing is completed and dry.
- .4 Sequencing:
 - .1 Ducts, piping and other items that would interfere with the application of fireproofing shall not be installed, until application is completed.
 - .2 Install steel decks and associated concrete work on decks before applying fireproofing to steel decks.
 - .3 Install complete roofing, rooftop mechanical units, and related work on the roof before applying fireproofing to roof decks.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product data and include product characteristics, performance criteria, dimensions, finishes, and limitations.
 - .2 Submit one electronic copy of WHMIS SDS - Safety Data Sheets.
- .3 Samples:
 - .1 Submit duplicate 300 x 300-mm samples of exposed fireproofing for approval of texture and colour.
- .4 Quality Assurance Submittals: Submit the following in accordance with Section 01 43 00 - Quality Assurance.
 - .1 Test Reports:
 - .1 Submit product data including certified copies of test reports that verify fireproofing applied to substrate as constructed on the project will meet or exceed the requirements of this Section.
 - .2 Submit test results in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.
 - .3 For assemblies not tested and rated, submit proposals based on related designs using accepted fireproofing design criteria.
 - .2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Manufacturer's Instructions: Submit manufacturer's application instructions, special handling criteria, minimum substrate preparation, application sequence, and cleaning warnings.
 - .4 Manufacturer's Site Reports: Submit manufacturer's written reports [within 3 days of] [promptly after] review, verifying compliance of this Section, as described in SITE QUALITY CONTROL in Part 3 of this Section.
- .5 Sustainable Design Submittals: Submit in accordance with Section.
 - .1 Low Emitting Materials:
 - .1 Submit manufacturer's information indicating VOC emission limit in grams per litre (g/L).

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Operation and Maintenance Data: Submit maintenance data for applied fireproofing and incorporate into manual.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: Company specializing in spray-applied fireproofing with five years documented experience.
- .2 Mock-ups: Construct mock-up in accordance with Section 01 43 00 - Quality Assurance.
 - .1 Apply fireproofing to approximately 1m² area of similar surface in a non-public area, such as a mechanical room.
 - .2 Mock-up will be used to judge workmanship, substrate preparation, and material application.
 - .3 Consultant will require a minimum of 24 hours to review the mock-up.
 - .4 Approved mock-up may remain as part of finished work.

- .3 Site Meetings: As part of Manufacturer's Services described under SITE QUALITY CONTROL in Part 3 of this Section, schedule site visits to review the work at the following stages:
 - .1 After delivery and storage of products when preparatory work is complete, but before application begins.
 - .2 During progress of work at 50% and 75% completion.
 - .3 Upon completion of work, after cleaning is completed.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Packing, Delivery, and Handling:
 - .1 Packaging to indicate shelf-life of materials.
 - .2 Deliver packaged materials in original unopened containers labeled with manufacturer, product name, and ULC markings.
 - .3 Damaged or opened containers will be rejected.
- .3 Storage and Protection:
 - .1 Store materials off ground in a dry, well-ventilated indoor location, and in accordance with manufacturer's recommendations.
 - .2 Provide temporary enclosures to prevent spray from contaminating air beyond application area.

1.7 SITE CONDITIONS

- .1 When ambient temperatures are less than 5°C, maintain 5°C air and substrate temperature during and for 24 hours after application.
- .2 Provide natural ventilation to properly dry the fireproofing during and after its application. In enclosed areas lacking openings for natural ventilation, circulate and exhaust interior air to the outside using forced air circulation providing a minimum of four air exchanges per hour.
- .3 Maintain relative humidity within limits recommended by fireproofing manufacturer.

PART 2 PRODUCTS

2.1 PERFORMANCE CRITERIA

- .1 Adhesion: Provide materials that meet or exceed adhesion requirements in accordance with ASTM E736/E736M.
 - .2 Thickness and Weight: Determine application thickness and weight of applied fireproofing based on tests of assemblies in accordance with CAN/ULC-S101. Apply same thickness of fireproofing material to all structural components forming a part of the assembly including; but not limited to, cross bracing, support angles and hangers.
 - .3 Only assemblies that have been tested in accordance with Limit States Design method are acceptable. Assemblies that require use of a Load Restricted factor in accordance with Working Stress Design methods are not acceptable.
 - .4 Engineered Judgements: Provide engineered judgement acceptable to authority having jurisdiction (AHJ) where the protected assembly differs from the tested assembly used to determine thickness.
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- .5 Spray-applied fireproofing must not crack, spall or delaminate under downward deflection conditions over a 3 m clear span.
- .6 Fungal Resistance: To ASTM G21, 28 days no growth.
- .7 Air Erosion: To ASTM E859/E859M, maximum 0.25 gram loss per square metre in 24 hours.
- .8 Provide materials containing no asbestos.
- .9 Spray-applied fireproofing must not contribute to corrosion of test panels.

2.2 MATERIALS

- .1 Sprayed Cementitious Fireproofing: ULC-certified, qualified for use in a ULC Design with fire-resistance rating times as indicated on Drawings for structure and floors at locations as indicated on Drawings.
- .2 Fireproofing: Minimum dry density and cohesion/adhesion properties as follows:
 - .1 Fireproofing for structural components concealed above ceiling, within walls, chases, or furred spaces: Minimum applied dry density of 240 kg/m³ and cohesion/adhesion strength of 9.57 kPa.
 - .2 Fireproofing for exposed structural components, except where otherwise specified or indicated: Minimum applied dry density of 350 kg/m³ and cohesion/adhesion strength of 20.83 kPa.
 - .3 Minimum compressive strength: 48 kPa.
- .3 Water: Clean, fresh, suitable for domestic consumption, and free from such amounts of mineral or organic substances that would affect setting of fireproofing materials.
- .4 Curing Compound: Type recommended by fireproofing manufacturer, qualified for use in the ULC Design submittal.
- .5 Sealer: Type recommended by fireproofing manufacturer, qualified for use in the ULC Design submittal, designed to prevent surface dusting.
 - .1 Colour: White

2.3 ACCESSORIES

- .1 Reinforcement mesh, wire lath, mould inhibitors and other components necessary for a complete and functioning fireproof coating.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Check environmental conditions and examine surfaces to receive fire resistant material - report any conditions that would be detrimental to the application of material.
- .2 Verification of Conditions: Verify that conditions of substrate previously installed are acceptable to begin fireproofing application in accordance with manufacturer's instructions:
 - .1 Visually inspect substrates.
 - .2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Where adjacent floors, walls and similar surfaces will be exposed, provide and maintain masking, drop cloths and polyethylene coverings for such surfaces to protect them during spraying operations.
 - .1 Protect adjacent surfaces and equipment from overspray, fall-out, and dusting of fireproofing materials.
- .2 Provide complete enclosures and human protective devices when spraying hazardous materials.
- .3 All surfaces to receive applied fire protection materials shall be free of oil, grease, dirt, loose paint, mill scale or any other matter that would impair bond, including paint unless test application of applied fire protection materials has been done to determine that paint formulation will not impair adhesion.
- .4 Prime surfaces as required by ULC Design.

3.3 APPLICATION

- .1 Apply bonding adhesive or primer to substrate if recommended by manufacturer.
- .2 Apply fireproofing to correspond with tested assemblies..
- .3 Apply fireproofing over substrate, building up to required thickness to cover substrate with monolithic blanket of uniform density and texture.
- .4 Apply fireproofing directly to open web joists without use of expanded lath.
- .5 Surface Finishing: Where indicated on Drawings, apply fireproofing to produce the following finishes:
 - .1 Manufacturer's standard finishes: Finish according to manufacturer's instruction for each finish specified.
 - .2 Spray-Textured Finish: Finish left as spray-applied with no further finishing.
 - .3 Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.
 - .4 Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth the texture and neaten edges.
 - .5 Skip-Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray-applied finish to a smooth texture, without surface markings, and with square edges.
- .6 Apply curing compound to surface of cementitious fireproofing as required by manufacturer.

3.4 REPAIR

- .1 Cut, patch, and repair materials which fail to meet requirements of this Section or which fail to attain properties stipulated in reports of tests used to determine fire-resistance rating of assembly.
 - .2 Repair damage to fireproofing caused by installation of subsequent work.
 - .3 Patch damage to fireproofing caused by testing or by other Subcontractors before fireproofing is concealed, or if exposed, before final review.
-

3.5 SITE QUALITY CONTROL

- .1 Manufacturer's Services:
 - .1 Obtain report from manufacturer of applied fire protection materials verifying compliance of Work in applying, and protecting of Products. Submit manufacturer's site reports as described in SUBMITTALS in Part 1 of this Section in an acceptable format to verify compliance of this Work with Contract [within three days of] [promptly after] inspection.
 - .2 Provide manufacturer's site services consisting of periodic site visits for inspection of product application in accordance with manufacturer's instructions.
 - .3 Schedule site visits to review Work, as directed under QUALITY ASSURANCE in Part 1 of this Section.
- .2 Inspection and Site Tests:
 - .1 Inspection and testing of applied fire protection will be carried out by a testing laboratory designated by Consultant to ASTM E605/E605M.

3.6 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Clean surfaces not indicated to receive fireproofing of sprayed material within 24 hours after application.
- .2 Waste Management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal.

3.7 PROTECTION

- .1 Protect applied products from damage during construction.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 ULC-S115, Fire Tests of Fire stop Systems.

1.2 DEFINITIONS

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 Tightly Fitted; penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.
 - .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.
 - .2 Construction details should accurately reflect actual job conditions.
 - .3 Engineering Judgements to be stamped by an engineer licensed to practice in the Province on Ontario
- .4 Samples:
 - .1 Submit duplicate 300 x 300 mm samples showing actual fire stop material proposed for project.
- .5 Quality assurance submittals: submit following in accordance with Section 01 45 00.
 - .1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.

- .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company specializing in fire stopping installations approved by manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate manufacturer &ULC markings.
- .4 Storage and Protection:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Replace defective or damaged materials with new.
 - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN- ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.
 - .2 Fire stop system rating as indicated.
- .2 Service penetration assemblies: systems tested to CAN-ULC-S115.
- .3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.
- .4 Fire-resistance rating of installed fire stopping assembly in accordance with OBC.
- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

- .9 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.
- .10 Sealants for vertical joints: non-sagging.
- .11 Refer to drawings sheet A090 for specific fire-stopping systems.

PART 3 EXECUTION

3.1 EXAMINATION MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
 - .1 Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.

3.4 SEQUENCES OF OPERATION

- .1 Proceed with installation only when submittals have been reviewed by Consultant.
- .2 Install floor fire stopping before interior partition erections.
- .3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding

- .4 Mechanical pipe insulation: certified fire stop system component.
 - .1 Ensure pipe insulation installation precedes fire stopping.

3.5 FIELD QUALITY CONTROL

- .1 Inspections: notify Consultant when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.7 SCHEDULE

- .1 Fire stop and smoke seal at:
 - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
 - .2 Top of fire-resistance rated masonry and gypsum board partitions.
 - .3 Intersection of fire-resistance rated masonry and gypsum board partitions.
 - .4 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
 - .5 Openings and sleeves installed for future use through fire separations.
 - .6 Around mechanical and electrical assemblies penetrating fire separations.
 - .7 Rigid ducts: greater than 129 cm²: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.
 - .8 Refer to drawings sheet A081 & A082 for specific fire-stopping systems.

END OF SECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- .1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

1.2 SUMMARY OF WORK

- .1 Work Included: The work of this Section includes the provision of all labour, materials, equipment and services required to execute sealant work, as indicated on the drawings, as specified herein and as required by job conditions and normally considered to be work covered by this Section.
- .2 The term "sealant" shall be interpreted as synonymous with the term "caulking" where used on the drawings and/or in the specifications.
- .3 Related Sections
 - .1 Section 06 40 00 - Architectural Woodwork and Casework
 - .2 Section 08 11 13 - Steel Doors and Frames
 - .3 Section 08 41 13 - Aluminum-Framed Entrances and Storefronts.
 - .4 Section 08 41 13 - Aluminum Windows
 - .5 Section 09 21 16 - Gypsum Board Assemblies.
 - .6 Section 09 30 13 - Ceramic Tile.
 - .7 Section 12 36 61.16 - Solid Surface Countertops

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C834-14, Standard Specification for Latex Sealants.
 - .2 ASTM C920-14a, Standard Specification for Elastomeric Joint Sealants.
- .2 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).

1.4 QUALIFICATIONS

- .1 The work of this Section shall be executed by an independent Trade Contractor whose primary business is in the application of caulking and sealants, using tradesmen skilled and trained in the techniques of caulking, and who are completely familiar with the published recommendations of the manufacturer of the caulking material being used.
- .2 If requested by the Consultant, provide evidence of previously completed projects of a similar nature.
- .3 Indication of lack of skill or defective work to be sufficient grounds for the Consultant to reject the installed caulking and to require its immediate removal and complete recaulking at no additional cost to the Owner during the warranty period.
- .4 Cooperate with the Consultant and/or any inspection and testing agency.

1.5 COMPATIBILITY

- .1 Sealants used for the various building interior assemblies shall be selected from those specified in the respective assembly Section, and shall be coordinated with the sealant being provided under other Sections. Preferably, one sealant of the same manufacturer shall be used throughout. If different sealants are selected, from those specified, it is the responsibility of the respective Section to ensure compatibility between selected sealant, substrates, and sealants of other Sections which come in contact with the selected sealant.

1.6 SUBMITTALS

- .1 General: Submit each item in this Article according to the Conditions of the Contract and the applicable Division 01 Specification Sections.
- .2 Prior to commencement of the work, submit, for each type of sealant, a certificate signed by the sealant manufacturer which states:
 - .1 surface preparation requirements
 - .2 priming and application procedures
 - .3 verification that sealant materials are selected for use from those specified
 - .4 verification that sealants are suitable for their locality, purposes intended and joint designs
 - .5 verification that sealants are compatible with other materials and products with which they come in contact, including but not limited to sealants provided under other Sections, and finishes
 - .6 verification that sealants will not stain the substrates or finished products
 - .7 verification that sealant is suitable for temperature and humidity conditions at the time of application
- .3 For each specified product, include manufacturer's material safety data sheets for the safe handling of the products, in accordance with WHMIS requirements.

1.7 ENVIRONMENTAL AND SAFETY REQUIREMENTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to Labour Canada.
- .2 Subject to compliance with other specification requirements, select low-odour, non-carcinogenic products in all locations for which such products are available.
- .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
 - .1 Do not apply sealants when the temperature of the sealant and the materials to which it is applied is below 5°C.
 - .2 Should it become necessary to apply sealants when the temperature is below 5°C, consult the sealant manufacturer and follow his recommendations.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact.
- .2 Store materials in strict accordance with the manufacturer's recommendations. Protect from freezing, moisture, water and contact with ground or floor.

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials, including packaging materials, in accordance with Section 01 74 21 "Construction Waste Management".
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely.

1.10 WARRANTY

- .1 For the work of this Section, the 12-months warranty period prescribed in the General Conditions of the Contract is extended to 5 years.
- .2 Warrant that caulking work will not leak, crack, crumble, melt, shrink, bubble, run, lose adhesion or stain adjacent surfaces.

PART 2 PRODUCTS

2.1 SEALANTS

- .1 Sealant Types:

Application	Type	Description	Movement Capability	Standards	Acceptable Products
Around interior door, frames and windows, against drywall and where acoustical sealant exposed to sight is called for	A	Paintable, siliconized, acrylic latex sealant		ASTM C834	Tremflex 834 Paintable, Siliconized Acrylic Latex Sealant
Exterior joint work, interior and exterior masonry control joints and where extreme movement is anticipated	B	Ultra-low-modulus, one-part, neutral-cure silicone sealant for extreme movement joints.	+ 100% - 50%	ASTM C920, Type S, Grade NS, Class 100/50 Use T, NT, M, G, A, O	No primer reqd. on concrete. Non-staining, good unprimed adhesion to most substrates (Fluoropolymer coatings, polyethylene faced mod-bit. membrane etc.)
Exterior joint work where not otherwise specified or indicated.	C	One-part, neutral- cure silicone sealant	+ 50%	ASTM C920, Type S Grade NS, Class 50 Use NT, M, G, A	Manufacturer to recommend Type C or D for specific application Note that Type C has a limited colour range
	D	One-part, neutral- cure, medium modulus, architectural grade, silicone sealant	+ 50%	ASTM C920, Type S Grade NS, Class 50 Use NT, G, A, O	

Sealant for caulking countertops at wall, ceramic tile, plumbing fixtures, and in wet areas where not otherwise specified	B	One-part, acetoxy-cure, mildew- resistant, silicone sealant for non-porous substrates	$\pm 25\%$		Dow Corning Tub, Tile & Ceramic Silicone Sealant
Acoustical Sealant in concealed locations	C	Flexible synthetic rubber acoustical sealant			Tremco Acoustical Sealant

- .2 Colour of sealants: selected from the manufacturer's complete colour range to match adjacent materials, to the approval of the Consultant.
- .3 Joint cleaner: xylol, methylethyleketon, IPA, or non-corrosive type recommended by sealant manufacturer and compatible with joint forming materials.

2.2 ACCESSORIES

- .1 Primers: type recommended by sealant manufacturer for each specific application.
- .2 Joint fillers: Chemically compatible with primers and sealants, outsized 30 to 50%, type recommended by sealant manufacturer for each specific application.
- .3 Bond breaker: pressure sensitive plastic tape, which will not bond to sealants.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Examine areas and conditions under which work is to be performed and notify the Consultant in writing of conditions detrimental to the proper and timely completion of the work.
- .2 For exterior sealants, arrange for a technical representative of the manufacturer to conduct adhesion tests for each joint condition and to make recommendations with respect to sealant type, primers (if required) and joint preparation. Do not deviate from the manufacturer's recommendations without prior written approval.
- .3 Do not proceed with the work until unsatisfactory conditions have been corrected to the satisfaction of the installer.
- .4 Commencement of the work of this Section will be construed as acceptance of the site conditions and, thereafter, the Contractor shall be fully responsible for satisfactory work as specified herein.

3.2 PREPARATION

- .1 Remove dust, paint, loose mortar and other foreign matter. Dry joint surfaces.
- .2 Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sandblasting.
- .3 Remove oil, grease and other coatings from non-ferrous metals with joint cleaner.

- .4 Prepare concrete, masonry, glazed and vitreous surfaces to sealant manufacturer's instructions.
- .5 Examine joint sizes and correct to achieve depth ratio 1/2 of joint width with minimum width and depth of 6 mm. Maximum width 75 mm.
- .6 Install joint filler to achieve correct joint depth and shape with approximately 30% compression.
- .7 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .8 Apply bond breaker tape where required to manufacturer's instructions.
- .9 Use primers where recommended by the sealant manufacturer. Prime sides of joints to sealant manufacturer's instructions immediately prior to caulking.

3.3 WORKMANSHIP

- .1 Caulk all joints between dissimilar materials.
- .2 Before application of any sealant, confirm that sealant material is compatible with the materials and finishes of the surfaces to which the material is applied or is in contact with.
- .3 Apply sealants in strict accordance with the manufacturer's printed directions for the specific applications of the particular materials used, using a gun with proper size nozzle. Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.
- .4 Concrete or masonry joints shall be a minimum of 6 mm wide x 6 mm deep. Depth shall be equal to width in joints up to 12 mm wide. For joints 12 mm to 25 mm wide, depth shall be 12 mm.
- .5 For joints in metal, glass and other non-porous surface, sealant depth shall be a minimum of 1/2 the applied sealant width, and shall in no case exceed the applied sealant width.
- .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities. Neatly tool surface to a slight concave joint.
- .7 Cure sealants in accordance with manufacturer's instructions. Do not cover up sealant until curing is complete and proper seal has been achieved.

3.4 SEALANT APPLICATION

- .1 Apply caulking around the perimeter of every wall and partition, both sides of openings in interior partitions; interior side of openings in exterior walls.
- .2 Apply sealant to all exposed control joints in masonry, concrete, and gypsum board walls, ceilings, and bulkheads, joints between adjacent building components.
- .3 Provide interior caulking in walls, floor finishes around all metal frames, door frames, access panels, built-in specialties; around pipes, ducts, grilles, outlet boxes, conduits, etc. penetrating floors, walls and ceiling.
- .4 Apply siliconized acrylic latex caulking around wood trim and wipe smooth prior to painting.
- .5 Caulk solidly around inside of all window/wall and door/wall joints, horizontal and vertical window and door surrounds, and all other trim, to provide a weathertight seal and prevent condensation.

- .6 Caulk the connection between the tops of the concrete block walls and the underside of the steel deck, wherever exposed to sight.
- .7 Caulk around plumbing fixtures, base and rim of sinks with mildew resistant sealant.
- .8 Supply and install paintable sealant around all piping to sinks and lavatories where piping passes through walls.

3.5 PREFORMED FOAM SEALANT INSTALLATION

- .1 Install preformed foam sealant in joints where indicated, in accordance with the manufacturer's printed instructions.
- .2 Verify dimensions on site and take particular care to select the correct size preformed sealant for the joint.
- .3 Install sealant to a clean line, flush with adjacent surfaces, and filling the joint, without interruption, for its entire length.

3.6 CLEANING

- .1 Upon completion of the work of this Section remove from the premises all surplus material, dirt and debris caused by the work of this Section and leave the installation clean.
- .2 Clean any drippage or spills of sealant or primers from adjacent surfaces immediately and make good any damage caused by the work of this Section, using cleaners recommended by the manufacturer, as work progresses.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 Aluminum Association (AA)
 - .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .2 ASTM International
 - .1 ASTM A 167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM D 412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
 - .3 ASTM D 2240-05(2010), Standard Test Method for Rubber Property - Durometer Hardness.
 - .4 ASTM D 2628-91(2011), Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
- .3 Canada Green Building Council (CaGBC)
 - .1 LEED (Leadership in Energy and Environmental Design) v4 for Building Design and Construction Rating System (July 25, 2019)
- .4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2011, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.
- .5 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .2 MPI #79 Primer, Alkyd, Anti-Corrosive for Metal.
 - .3 MPI #80 Primer, Vinyl Wash.
 - .4 MPI #95 Primer, Quick Dry, for Aluminum.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for expansion joint cover assemblies and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate on drawings:
 - .1 Lengths, fasteners, accessories, anchors, seals, butt joints and locations finishes and profiles required for each condition.
- .4 Samples:
 - .1 Submit 150 mm long samples of each type and finish expansion joint cover assemblies.

- .5 Sustainable Design Submittals:
 - .1 Low-Emitting Materials:
 - .1 Submit listing of coatings and sealers used in building, showing compliance with VOC and chemical component limits or restriction requirements.

1.3 QUALITY ASSURANCE

- .1 Certificates:
 - .1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .2 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.
- .3 Manufacturers Field Services:
 - .1 Submit manufacturers field reports.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect expansion joint cover assemblies from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- .1 Joint movement: design to permit unrestricted lateral, vertical and omnidirectional movement of up to +/-50% of joint width.
 - .2 Service Temperature: design exterior expansion joint cover assemblies to accommodate joint movements within service temperature range of -35 degrees C to 65 degrees C.
-

2.2 MATERIALS

- .1 Exterior Wall Joint Seal:
 - .1 Description: Silicone coated, ultraviolet resistant, watertight, primary wall seal with factory-applied adhesive on one side.
 - .1 Form: Precompressed to less than nominal material size for installation into designed joint size equal to material nominal size.
 - .2 Movement capability: Plus and minus 50% (total 100%) of nominal material size.
 - .3 R-value: 2.15 per inch depth at nominal joint size compression, tested to ASTM C518.
 - .4 STC rating: 52 in STC 56 wall, tested to ASTM E90.
 - .5 OITC rating: 38 in OITC 38 wall, tested to ASTM E90.
 - .6 Air permeability: Maximum 0.02 liter per second per square meter, tested to ASTM E283 at 75 Pa.
 - .7 Water penetration: No water penetration, tested to ASTM E331 at 5000 Pa test pressure.
 - .8 Wind loading:
 - .1 0.1 mm net deflection, tested to ASTM E330 at 2730 Pa or 150 MPH wind.
 - .2 0.6 mm net deflection, tested to ASTM E330 at 4854 Pa or 200 MPH wind.
 - .9 Weathering: Sealing of outside wall joints per DIN 18542-1999 / G155-2013: Pass
 - .10 VOC Emissions: CDPH-1.2-2017: Pass
 - .11 Color: To be selected from Sika Emseal full color range.
 - .12 Silicone: Field applied corner bead at face of seal to substrate interface, furnished by joint seal manufacturer, in same material and color as used in factory coating.
 - .1 Abrasion Resistance: Less than 1% weight loss, tested to ASTM D4060.
 - .2 Fuel Resistance: Pass, tested to ASTM C719/C1135.
 - .2 Basis of Design: Seismic Colorseal by Sika Emseal.
- .2 Roof Joint Seal:
 - .1 Description: Dual-seal, double-flanged, extruded thermoplastic rubber system for sealing expansion joints in roofs. Watertightness is achieved through positive integration with the roofing membrane and a purpose-designed system for transitioning between the joint in the roof and joints in walls
 - .1 Properties:
 - .1 Tensile Strength to ASTM D412: MD = 2,320 / Std. Dev. 40
 - .2 Elongation to ASTM D412: MD = 380 / Std. Dev. 20
 - .3 Static Puncture Resistance to ASTM D5602: 53
 - .4 Tear Resistance to ASTM D624:
 - .1 MD = 306
 - .2 CMD = 299
 - .5 Water Absorption to ASTM D1149B: Ave. 1.4
 - .6 Water Vapour Permeance to ASTM E96: Ave. 0.04
 - .2 Basis of Design: RoofJoint by Sika Emseal

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for expansion joint cover assemblies installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed Consultant.

3.2 MANUFACTURER'S RECOMMENDATIONS

- .1 Comply with manufacturer's written data, including product technical bulletins, product catalogue installation recommendations, product carton installation recommendations and data sheets.

3.3 INSTALLATION

- .1 Set work plumb, square, level, free from distortion.
- .2 Secure work accurately to structure in manner not restricting joint movement.
- .3 Maintain continuity of air barrier and vapour retarder.
- .4 Seal butt joints in accordance with manufacturer's written recommendations to provide watertight and light tight joints using sealant.
- .5 Protect cover plates during construction. Remove shop protection prior to final inspection.
- .6 Ensure sound and clean substrates before installation.

3.4 FIELD QUALITY CONTROL

- .1 Have manufacturer of products supplied under this Section review Work involved in handling, installation/application, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.
- .2 Manufacturer's field services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.
- .4 Obtain reports within three days of review and submit.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .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 - Cleaning.
- .3 Remove traces of primer, caulking, epoxy and filler materials; clean expansion joint covers.
- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by control and expansion joint cover assembly installation.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 07 92 00 - Joint Sealants
- .2 Section 08 71 00 - Door Hardware
- .3 Section 08 80 00 - Glazing
- .4 Section 08 90 00 - Louvres and Vents
- .5 Section 09 91 13 - Exterior Painting
- .6 Section 09 91 23 - Interior Painting

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM A653/A653M-18, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 ASTM A780/A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - .3 ASTM A924/A924M-22a, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
 - .4 ASTM B749-25, Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products
 - .5 ASTM D4726-24, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Exterior-Profile Extrusions Used for Assembled Windows and Doors
 - .6 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
 - .7 ASTM E413-16, Classification for Rating Sound Insulation
 - .8 ASTM F2247-18, Standard Test Method for Metal Doors Used in Blast Resistant Applications (Equivalent Static Load Method)
- .2 California Air Resources Board (CARB):
 - .1 2007 [Suggested Control Measure \(SCM\) for Architectural Coatings](#)
 - .2 product declarations. Core rules for the product category of construction products
- .3 CSA Group (CSA):
 - .1 AAMA/WDMA/CSA 101/I.S.2/A440-17, North American Fenestration Standard/Specification for windows, doors, and skylights
 - .2 CSA A440S1:19, Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440-11, North American Fenestration Standard/Specification for windows, doors, and skylights
 - .3 CSA G40.20-13 /G40.21-13, General requirements for rolled or welded structural quality steel/Structural quality steel
 - .4 CSA W47.1:19, Certification of companies for fusion welding of steel
 - .5 CSA W59:24, Welded steel construction
- .4 Canadian Steel Door Manufacturers Association (CSDMA):
 - .1 Guide Specification for Installation and Storage of Hollow Metal Doors and Frames, 2012
 - .2 Recommended Specifications for Commercial Steel Door and Frame Products, 2022

- .5 Green Seal (GS):
 - .1 GS-11-21, Paints, Coatings, Stains, and Sealers
 - .2 GS-36-13, Adhesives for Commercial Use
- .6 Master Painters Institute (MPI):
 - .1 [Approved Products List \(APL\), online edition](#)
- .7 National Fire Protection Association (NFPA):
 - .1 NFPA 80-2013, Standard for Fire Doors and Other Opening Protectives
- .8 South Coast Air Quality Management District (SCAQMD):
 - .1 SCAQMD Rule 1113-2016, Architectural Coatings
 - .2 SCAQMD Rule 1168-2022, Adhesive and Sealant Applications
- .9 Steel Door Institute (SDI):
 - .1 SDI 108-10, Recommended Selection and Usage Guide for Standard Steel Doors
 - .2 SDI 111-24, Recommended Details for Standard Steel Doors, Frames, Accessories and Related Components
 - .3 SDI 122-21, Installation Troubleshooting Guide for Standard Steel Doors and Frames
- .10 Underwriters' Laboratories Inc. (UL):
 - .1 UL 2761-2011, Standard for Sustainability for Sealants and Caulking Compounds
 - .2 UL 2762-2011, Standard for Sustainability for Adhesives
- .11 ULC Standards (ULC):
 - .1 CAN/ULC-S104-15, Standard Method for Fire Tests of Door Assemblies
 - .2 CAN/ULC-S105:16, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104
 - .3 CAN/ULC-S701.1:2017, Standard for Thermal Insulation, Polystyrene Boards
 - .4 CAN/ULC-S702.1-14, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification
 - .5 CAN/ULC-S704.1:2017, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced
 - .6 CAN/ULC-S705.1:2018, Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material Specification

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with Section 08 71 00 - Door Hardware for:
 - .1 manufacturers' door hardware templates
 - .2 reinforcement required to secure hardware
 - .3 hardware required to attain fire-protection ratings
- .2 Pre-installation meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by Consultant and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review installation and substrate conditions.
 - .4 Coordinate with other Subcontractors.
 - .5 Review manufacturer's instructions and warranty requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: Product literature and data sheets for each type of door and frame, including product characteristics, performance criteria, physical sizes, finishes, example warranty documentation, core descriptions, fire-protection ratings, sound transmission class (STC) ratings, and limitations.
- .3 Shop drawings:
 - .1 For each type of door, indicate materials, steel core thicknesses, mortises, reinforcements, locations of exposed fasteners, openings, glazing, louvres, hardware arrangements, fire-protection ratings, STC ratings, and finishes.
 - .2 For each type of frame, indicate materials, core metal thicknesses, reinforcements, glazing stops, locations of anchors and exposed fastenings, fire-protection ratings, STC ratings, and finishes.
 - .3 Include a Schedule identifying each unit with door marks and numbers matching numbering on Drawings and Door Schedule.
- .4 Certificates: Certifying work of this section complies with specified performance characteristics and physical properties, and signed by the independent testing agencies.
 - .1 Where fire-protection-rated doors or frames exceeds size limitations of fire labelled assemblies, submit evidence indicating compliance with fire labelling for door and frame assemblies.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance data:
 - .1 Include, in the operation and maintenance manual, manufacturer's maintenance instructions and recommended cleaning materials and methods.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturers: Member in good standing of the Canadian Steel Door Manufacturers Association.
 - .2 Installers:
 - .1 Installers performing on-site steel welding: Certified by the Canadian Welding Bureau to CSA W47.1.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements, and:
 - .1 Comply with CSDMA's Guide Specification for Installation and Storage of Hollow Metal Doors and Frames.

1.8 WARRANTY

- .1 Submit warranty information in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Manufacturer warranty: Manufacturer's standard warranty document, executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights the Owner may have under the Contract.

- .3 Manufacturer's warranty period: [10] years minimum.

PART 2 PRODUCTS

2.1 HOLLOW METAL DOOR AND FRAMES

- .1 Manufacturers:
 - .1 Provide doors and frames from a single manufacturer.
- .2 Regulatory requirements:
 - .1 Fire-protection-rated doors, frames, and screens: Labelled and listed by an organization accredited by Standards Council of Canada in accordance with CAN/ULC-S104 and CAN/ULC-S105 for ratings indicated.
 - .2 Affix appropriate labels to each opening, to indicate:
 - .1 At standard size openings: Fire-protection rating.
- .3 Performance/design criteria:
 - .1 Design exterior frame assembly to accommodate expansion and contraction when subjected to a minimum and maximum surface temperature of -35 °C to 35 °C.
 - .2 Design exterior door and frame assemblies in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 and CSA A440S1:
 - .1 Performance class: R.
 - .2 Design pressure (DP): Minimum 2000 Pa.
 - .3 Water penetration test pressure: Minimum 220 Pa.
 - .4 Air infiltration/exfiltration: A3.
 - .3 Maximum deflection for exterior entrance screens under wind load of 1.2 kPa: 1/175th of span.

2.2 MATERIALS

- .1 Metals:
 - .1 Description:
 - .1 Steel: Commercial grade steel to ASTM A568/A568M, wipe coat galvanized steel, coating designation ZF001 (A01), minimum base steel thickness unless noted otherwise:
 - .1 Base metal thicknesses:
 - .1 Frames: 1.6 mm (16 ga).
 - .2 Door faces: 1.2 mm (18 ga).
 - .3 Top and bottom end channels: 1.2 mm (18 ga).
 - .2 Reinforcements:
 - .1 Lock and strike reinforcements: 1.6 mm (16 ga).
 - .2 Hinge reinforcements: 3.4 mm (10 ga).
 - .3 Flush bolt reinforcements: 1.6 mm (16 ga).
 - .4 Door closer and holder reinforcements: 2.7 mm (12 ga).
 - .2 Sustainability characteristics:
 - .1 Recycled content: Minimum 75% post-consumer and pre-consumer.
- .2 Door core materials:
 - .1 Honeycomb construction (Interior Doors):
 - .1 Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m³ minimum sanded to required thickness.
 - .2 Stiffened (Exterior Doors): face sheets welded, un-insulated and insulated core as indicated:
 - .1 Expanded polystyrene: CAN/ULC-S701, density 16 to 32 kg/m³.
 - .2 Polyurethane: to CAN/ULC-S704 rigid, modified polyisocyanurate, closed cell board. Density 32 kg/m³.

- .3 Adhesives:
 - .1 Types:
 - .1 Honeycomb core and steel component adhesive: Heat-resistant, spray-grade polyurethane.
 - .2 Polystyrene and polyurethane core adhesive: Heat-resistant, epoxy-resin based, low-viscosity contact cement.
 - .3 Lock-seam edge adhesive: Fire-resistant, resin-reinforced polychloroprene, high viscosity, sealant/adhesive.
 - .2 Sustainability characteristics:
 - .1 VOC and other chemical limits: To GS-36.
- .4 Floor anchors and channel spreaders: 1.70 -mm-thick steel tee anchors, 1.34 -mm-wall stud anchors, and provide anchors appropriate to site conditions, as follows:
 - .1 Exterior locations: Hot-dipped, zinc-coated.
 - .2 Interior locations: Wipe coat galvanized.
 - .3 At masonry: Corrugated, galvanized tee anchors or heavy-gauge galvanized wire ties.
 - .4 Drilled stud anchors for wire tie to studs.
- .5 Thermal breaks: To CGSB 41-GP-19Ma, rigid polyvinyl chloride extrusions.
- .6 Glazing: in accordance with Section 08 80 00 - Glazing.
- .7 Glazing stops:
 - .1 Make openings for glazing and louvres as indicated on Drawings and provide necessary glazing stops on secure sides or inside rooms.
 - .2 Fabricate formed channel glazing stops for fastening to frames, doors, or both, minimum 16 mm high, accurately fitted, butted at corners , for use with glazing tapes and compounds.

2.3 FRAME FABRICATION

- .1 Fabricate door sidelight and window frames in accordance with CSDMA's Recommended Specifications for Commercial Steel Door and Frame Products.
- .2 Fabricate frames to profiles and maximum face sizes as indicated on Drawings. Coordinate throat dimensions based on actual material used for adjacent wall and partition construction assemblies.
- .3 Cut mitres accurately and [weld] [secure bent tabs] on inside of frame profile.
- .4 Reinforce head of frames wider than 1200 mm with 2.5 mm formed steel channel welded in place, flush with top of frame.
- .5 Exterior frame construction: Thermally broken type.
 - .1 Thermally-broken frames: Separate exterior parts from interior parts with continuous interlocking thermal breaks.
- .6 Interior frame construction: Welded type.
- .7 Blank, reinforce, drill, and tap frames for mortised, templated hardware, and electronic hardware. Use templates provided by door hardware suppliers. Reinforce frames for surface-mounted hardware.
- .8 Protect mortised cut-outs with steel guard boxes.

- .9 Prepare door openings for door silencers:
 - .1 Three silencers on strike jamb for single door openings.
 - .2 Two silencers on heads for double door openings.
- .10 Manufacturer's nameplates on frames and screens are not acceptable.
- .11 Conceal fasteners except where exposed fastenings are indicated on Drawings.
- .12 Touch up areas where zinc coating has been removed during fabrication with shop-applied primer.
- .13 Insulate exterior frame components with polyurethane insulation.
- .14 Frame anchorage:
 - .1 Provide concealed anchorage to floor and wall construction.
 - .2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
 - .3 Provide two anchors for rebate opening heights up to 1520 mm, and one additional anchor for each additional 760 mm of height or fraction thereof.
 - .4 Locate anchors for frames in previously placed concrete, masonry, or structural steel maximum 150 mm from top and bottom of each jamb, and intermediate anchors at maximum 660 mm on-centre.

2.4 WELDED TYPE FRAME FABRICATION

- .1 Perform welding to CSA WS59.
- .2 Accurately mitre or mechanically joint frame products. Securely weld on inside of profile.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails, and sills.
- .4 Grind welded joints and corners flat, fill with metallic paste filler, and sand to uniform smooth finish.
- .5 Securely attach floor anchors to inside of each jamb profile.
- .6 Weld in two temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.5 DOOR FABRICATION

- .1 Doors: Swing type, flush, with provision for glazed and louvred openings as indicated on Drawings.
- .2 Fabricate doors with longitudinal edges continuously welded, filled, and sanded.
 - .1 Seams: Grind welded joints flat, fill with metallic paste filler and sand to uniform, smooth finish.
- .3 Cores:
 - .1 Exterior doors: Expanded polystyrene or Polyurethane.
 - .1 Separate exterior door parts from interior parts with continuous interlocking thermal breaks.
 - .2 Interior doors:
 - .1 Typical: Honeycomb.
 - .3 Laminate core materials to face sheets under pressure.
- .4 Blank, reinforce, drill, and tap doors for mortised, templated hardware and electronic hardware. Reinforce doors for surface-mounted hardware where required.
- .5 Factory prepare 13 mm diameter holes and larger on-site at time of hardware installation, except for mounting and through-bolt holes.

- .6 Provide flush top caps to exterior doors. Provide inverted top and bottom channels to interior doors.
- .7 Manufacturer's nameplates on doors are not acceptable, except on hinge edges.
- .8 Touch-up areas where zinc coating has been removed during fabrication with shop-applied primer.
- .9 Reinforced steel doors:
 - .1 Reinforce doors with vertical stiffeners, securely laminated to face sheets at a maximum 150 mm on-centre.
 - .2 Fill voids between stiffeners of exterior doors with fibreglass core.
 - .3 Fill voids between stiffeners of interior doors with honeycomb core.

2.6 ACCESSORIES

- .1 Exposed fasteners: Type 304 stainless steel.
- .2 Labels for fire-protection-rated doors and frames: Metal riveted.
- .3 Door silencers/bumpers: [In accordance with Section 08 71 00 - Door Hardware.
- .4 Touch-up primers: To CAN/CGSB-1.181.
 - .1 Coordinate with Section 09 91 13 - Exterior Painting and Section 09 91 23 - Interior Painting for compatibility between primers used on doors and frames and specified paint systems.
 - .2 Sustainability characteristics:
 - .1 VOC and other chemical limits for on-site, wet-applied products: To CARB SCM for Architectural Coatings.
- .5 Polyurethane insulation: To CAN/ULC-S705.1, low-pressure, spray-applied rigid polyurethane foam.
 - .1 Regulatory requirements:
 - .1 Blowing agents: GWP less than 150.
 - .2 Material: Contains no CFC, HCFC, or HFC listed in Table 4, Schedule 1 of SOR/2016-137.
- .6 Metallic paste filler: Manufacturer's standard.
- .7 Door top caps:
 - .1 Exterior doors: To CGSB 41-GP-19Ma, rigid polyvinylchloride extrusion conforming to flush.
 - .2 Interior: Steel channels.
- .8 Isolation coatings: Epoxy resin solutions, alkali-resistant.
 - .1 Sustainability characteristics:
 - .1 VOC and other chemical limits for on-site, wet-applied products: To CARB SCM for Architectural Coatings.
- .9 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
 - .1 Sustainability characteristics:
 - .1 VOC and other chemical limits for on-site, wet-applied products: To Section 07 92 00 - Joint Sealants.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Site measurements:
 - .1 Measure constructed opening dimensions on site. Indicate measured opening dimensions on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
 - .2 When site measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating doors and frames without site measurements. Coordinate site construction to ensure opening dimensions correspond to established dimensions.
- .2 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation.

3.2 INSTALLATION

- .1 Install doors and frames to CSDMA's Guide Specification for Installation and Storage of Hollow Metal Doors and Frames.
- .2 Install fire-protection-rated doors and frames in accordance with NFPA 80.
- .3 Protect metal surfaces in contact with concrete, masonry, mortar, plaster, or other cementitious surface with isolation coating.
- .4 Install door hardware in accordance with Section 08 71 00 - Door Hardware, using manufacturer's door hardware templates.
- .5 Install glazing in accordance with Section 08 80 00 - Glazing.
- .6 Frames:
 - .1 Install suitable floor plates to anchor frames to floor assemblies.
 - .2 Set frames plumb, square, level, and at correct elevation.
 - .3 Secure anchors and connections to adjacent construction.
 - .4 Brace frames rigidly in position until built-in:
 - .1 Remove temporary jamb spreaders.
 - .2 Provide temporary wood spreaders at third points of frame rebate height to maintain frame width until adjacent built-in work is complete.
 - .3 Provide vertical support at centre of head for openings exceeding 1200 mm in width.
 - .4 Remove wood spreaders after frames are built-in.
 - .5 Allow for structural deflection to ensure structural loads are not transmitted to frames.
 - .6 Fill gaps between rough openings and frames with polyurethane insulation.
 - .7 Apply sealant at perimeter of frames [between frame and adjacent material].
 - .8 Maintain continuity of air barrier and vapour retarder by sealing membrane to frame.
 - .9 Install door silencers.
- .7 Louvres: Install in accordance with Section 08 90 00 - Louvres and Vents.
- .8 Tolerances:
 - .1 Provide even margins between doors and jambs, and doors and finished floors and thresholds.
 - .1 Hinge side: 1.0 mm.
 - .2 Latch side and head: 1.5 mm.
 - .3 Finished floors , non-combustible sills and thresholds: Maximum 19 mm.

3.3 ADJUSTING

- .1 Touch-up finishes damaged during installation with primer.
- .2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler. Sand to uniform, smooth finish.
- .3 Repair damage to zinc coatings [in accordance with ASTM A780/A780M].
- .4 Adjust operable parts for correct function.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning, and:
 - .1 Remove traces of primer, sealants, epoxy, and filler materials. Clean doors and frames.
 - .2 Clean glass and glazing materials with approved non-abrasive cleaner.
- .2 Waste management:
 - .1 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal.

3.5 PROTECTION

- .1 Protect partially installed and completed work from damage in accordance with Section 01 76 00 - Protecting Installed Construction, and:
 - .1 Install temporary protective covering to exposed components.
 - .2 Lock operative door bottoms in up position.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS:

- .1 Section 07 21 19 - Urethane Foam Insulating Sealant.
- .2 Section 07 27 00 - Air Barriers and Waterproofing.
- .3 Section 07 92 00 - Joint Sealants.
- .4 Section 08 71 10 - Door Hardware.
- .5 Section 08 80 50 - Glazing.

1.2 REFERENCES

- .1 Aluminum Association (AA):
 - .1 AA-DAF-45-2003, Designation System for Aluminum Finishes.
 - .2 AA Aluminum Standards and Data - 2006.
- .2 American Architectural Manufacturers Association (AAMA):
 - .1 AAMA 1503-98(R2004), Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
- .3 American Society for Testing and Materials (ASTM):
 - .1 ASTM E283-04, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - .2 ASTM E330-02, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 - .3 ASTM E331-00, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference.
- .4 Canadian Standards Association: (CSA):
 - .1 CAN/CSA-G40.20-04, General Requirements for Rolled or Welded Structural Quality Steel.
 - .2 CAN/CSA-G40.21-04, Structural Quality Steels.
 - .3 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .4 CAN3 S157/S157.1-05, Strength Design in Aluminum / Commentary on CSA Steel 157-05 Strength Design in Aluminum.
- .5 The Society for Protective Coatings (SSPC):
 - .1 SSPC-Paint 12 1982, Paint Specification No. 12: Cold Applied Asphalt Mastic (Extra Thick Film).

1.3 REGULATORY REQUIREMENTS

- .1 The work of this Section shall conform to the requirements of the OBC 2015, latest revision, and all other applicable codes and regulations, to the satisfaction of the authorities having jurisdiction.

1.4 DESIGN CRITERIA AND PERFORMANCE

- .1 Design frames and doors in exterior walls to accommodate expansion and contraction within an ambient temperature range of -35oC to +35oC.

- .2 Structural performance shall be based on CAN3 S157 and a maximum deflection of 1/175 of the span.
- .3 Design Aluminum Framed Entrances and Storefronts to resist effects of earthquake motions under seismic design conditions for Post Disaster buildings as specified in the Contract Documents and specifically on drawing S000 item D01-3 SEISMIC SYSTEM/LOADING DATA. Provide components as necessary to implement the design.
- .4 Air infiltration for exterior doors and frames shall not exceed 2.78 m³/h.m for a single door or 5.56 m³/h.m for a pair of double doors, when tested in accordance with ASTM E283 at a pressure differential of 75 Pa.
- .5 Thermally, the grid members of exterior frames shall have a condensation resistance equal to, or better than, the area along the bottom of a 25 mm sealed glass unit with standard metal spacer edge construction.

1.5 SUSTAINABILITY REQUIREMENTS

- .1 Give preference to Products containing the highest percentage of recycled material content.
- .2 Where possible, provide Products which are regionally manufactured and extracted.
- .3 Comply with the requirements of Section 01 35 43 "Environmental Procedures".
- .4 Cooperate with the Waste Management Coordinator in the implementation of the Waste Management Plan specified in Section 01 74 19 "Waste Management and Disposal". Handle and dispose of waste materials generated by the work of this Section in accordance with the Waste Management Plan.

1.6 SUBMITTALS

- .1 General: Submit each item in this Article according to the Conditions of the Contract and the applicable Division 01 Specification Sections.
- .2 Shop Drawings:
 - .1 Indicate each type of door and frame, extrusion profiles, method of assembly, section and hardware reinforcement, locations of exposed fasteners, finishes and location of manufacturer's nameplates.
 - .2 Submit catalogue details for each type of door and frame illustrating profiles, dimensions and methods of assembly.
 - .3 Coordinate with other Sections and ensure that shop drawings are submitted early enough in the schedule to permit review prior to the work of any trade required to build in items for this Section. For example: inserts or weld plates, for anchorage, required to be built into cast in place concrete work.
 - .4 Maintenance Data: Provide maintenance data for cleaning and maintenance of aluminum finishes for incorporation into the manual specified in Section 01 78 00 "Closeout Submittals".

1.7 PROTECTION

- .1 Apply temporary protective coating to finished surfaces. Remove coating after erection. Do not use coatings that will become hard to remove or leave residue.
- .2 Leave protective covering in place until final cleaning of building.

1.8 WARRANTY

- .1 For the work of this Section, the 12-months warranty period prescribed in the General Conditions of the Contract, is extended to 5 years.

PART 2 PRODUCTS

2.1 GENERAL

- .1 This specification is based on glazed aluminum doors and frames as manufactured by Alumicor.
- .2 Subject to compliance with the specification requirements, equivalent products by the following manufacturers are acceptable alternatives:
 - .1 Commdoor
 - .2 Cahill Commercial
- .3 Requests for substitutions will be considered in accordance with provisions of Section 01 25 00 "Substitution Procedures". Acceptance of alternative products is subject to the approval of the Consultant.

2.2 MATERIALS

- .1 Aluminum extrusions: Aluminum Association alloy AA6063 T5 anodizing quality.
- .2 Sheet aluminum: Aluminum Association alloy AA1100 H14 anodizing quality.
- .3 Steel reinforcement, fastening clips, etc.: to CAN/CSA G40.21, hot dip galvanized to CAN/CSA G164.
- .4 Fasteners: 300 Series stainless steel or 400 Series cadmium plated stainless steel of sufficient size and quantity to perform their intended function, finished to match adjacent material.
- .5 Weatherstrip: replaceable mohair metal backed wool pile.
- .6 Door bumpers: black neoprene.
- .7 Threshold: Aluminum extrusion, 12.7 mm high x extended width to cover top of foundation wall x length to suit. Aluminum Association alloy AA6063 T5, mill finish. Provide cadmium plated steel fasteners as required.
- .8 Door bottom seal: Adjustable door seal of anodized extruded aluminum frame and vinyl weather seal, recessed in door bottom, closed ends.
- .9 Isolation coating: Alkali resistant bituminous paint to SSPC Paint-12 applied at rate of 1 l/m2.
- .10 Glass and glazing materials: Provided by this Section in accordance with Section 08 80 50 "Glazing".
- .11 Sealants: Refer to Section 07 92 00 "Joint Sealants".
- .12 Door hardware: Refer to Section 08 71 10 "Door Hardware".

2.3 GLAZED ALUMINUM DOORS

- .1 Framed Aluminium doors:
 - .1 Glazed doors:
 - .1 Exterior: Alumicor ThermaPorte 7700, Model T600A thermally broken.
 - .1 Alternate Manufacturers:
 - .1 4400 Series by Commdoor
 - .2 CA720 Series by Cahill Commercial
 - .2 Interior: Alumicor Canadiana HD Model 800A.
 - .1 Alternate Manufacturers:
 - .1 500 Series by Commdoor
 - .2 CA230 Series by Cahill Commercial
- .2 Construct doors of porthole extrusions with minimum wall thickness of 3 mm.
- .3 Exterior Stile and rail dimensions, exclusive of glazing stops, to be as follows:
 - .1 Door stiles nominal 146.1 mm wide.
 - .2 Top rail nominal 142.9 mm wide.
 - .3 Bottom rail nominal 177.8 mm wide.
 - .4 Thickness: 57 mm.
- .4 Interior Stile and rail dimensions, exclusive of glazing stops, to be as follows:
 - .1 Door stiles nominal 101.6 mm wide.
 - .2 Top rail nominal 115.9 mm wide.
 - .3 Bottom rail nominal 203.2 mm wide.
 - .4 Thickness: 45 mm.
- .5 Performance Requirements:
 - .1 Ensure system is designed to accommodate the following without damage to components or deterioration of seals:
 - .1 Thermal Resistance of:
 - .1 System U-Value: 0.35 maximum.
- .6 Reinforce mechanically joined corners of doors to produce sturdy door unit.
- .7 Glazing stops: interlocking snap in type for dry glazing.
- .8 Exterior stops: tamperproof type.

2.4 ALUMINUM FRAMES: EXTERIOR

- .1 Exterior aluminum frames: FlushGlaze BF 3400, thermally broken and insulated, as follows:
 - .1 Construct frames of aluminum extrusions with minimum wall thickness of 3 mm.
 - .2 Assembled frame members to be 51 mm wide x 114 mm deep.

2.5 ALUMINUM FRAMES: INTERIOR

- .1 Interior aluminum frames to be FlushGlaze TL1800, flush glazed.
 - .1 Frames shall be box sections without thermal break, of aluminum extrusions with minimum wall thickness of 3 mm.
 - .2 Frame members to be 51 mm wide x 114 mm deep.

2.6 FINISHES

- .1 Finish aluminum surfaces with electrolytically deposited, Black anodic finish, designation AA M10 C21 A41, Architectural Class I, in accordance with AA-DAF-45.
- .2 Steel clips and reinforcement: 380 g/m2 zinc coating to ASTM A123.
- .3 Isolate aluminum from the following components by a heavy coating of bituminous coating:
 - .1 Dissimilar metals except stainless steel, zinc or white bronze in small area.
 - .2 Concrete, mortar and masonry.
 - .3 Wood.

2.7 FABRICATION

- .1 Doors and framing to be by same manufacturer.
- .2 Fabricate doors and frames to profiles and maximum face sizes as shown. Provide minimum 22 mm bite for insulating glazed units.
- .3 Provide structural steel reinforcement as required.
- .4 Fit joints tightly and secure mechanically.
- .5 Conceal fastenings.
- .6 Design anchorages so that they do not interfere with other work such as floor finishes of drywall finishes to walls.
- .7 Mortise, reinforce, drill and tap doors, frames and reinforcements to receive hardware using templates provided by Section 08 71 10 "Door Hardware".
- .8 Coordinate installation of hardware in the doors and frames to ensure proper operation of the completed installation.
- .9 Isolate aluminum from direct contact with dissimilar metals, concrete and masonry.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Examine areas and conditions under which work is to be performed and notify the Consultant in writing of conditions detrimental to the proper and timely completion of the work.
- .2 Do not proceed with the work until unsatisfactory conditions have been corrected to the satisfaction of the installer.
- .3 Take field measurements to verify or supplement dimensions.
- .4 Commencement of the installation will be construed as acceptance of the site conditions and, thereafter, the Contractor shall be fully responsible for satisfactory work as specified herein.

3.2 INSTALLATION

- .1 Set frames plumb, square, level at correct elevation in alignment with adjacent work.

- .2 Anchor securely.
- .3 Brace frames rigidly for building in. Install temporary horizontal wood spreaders at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders and supports after frames are built in.
- .4 Install doors and hardware in accordance with hardware templates and manufacturer's instructions.
- .5 Adjust operable parts for correct function.
- .6 Make allowances for deflection of structure to ensure that structural loads are not transmitted to frames.

3.3 GLAZING

- .1 Glaze aluminum doors and frames in accordance with Section 08 80 50 "Glazing" and the manufacturer's standard glazing methods and materials.

3.4 AIR/VAPOUR SEAL

- .1 Ensure airtight connections with adjacent construction to maintain the airseal over the entire building envelope.
- .2 Coordinate with the building air/vapour barrier installer and install air/vapour barrier transition strips at the interface with adjacent construction. Refer to details.
- .3 Inspect the entire assembly for gaps in the air seal and make good.

3.5 CAULKING

- .1 Seal joints to provide weathertight seal at outside and air, vapour seal at inside.
- .2 Apply sealant in accordance with Section 07 92 00 "Joint Sealants". Conceal sealant within the aluminum work except where exposed use is permitted by the Consultant. Colour of exposed sealant to match finish to the approval of the Consultant.

3.6 PROTECTION

- .1 During and after installation, protect the work of this Section from damage. Remove all corrosive or foreign material or droppings resulting from the work of this or other trades.
- .2 Do not use coatings that will become hard to remove or leave residue.

3.7 FINAL CLEANING

- .1 Remove protective coating and clean all surfaces, using materials and methods recommended by the door and frame manufacturer.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Flush wood doors.
 - .2 Plastic-laminate-faced wood doors.
 - .3 Wood doors with a fire-protection rating, and door components required for rating.
 - .4 Factory finishing.

1.2 RELATED REQUIREMENTS

- .1 Section 08 11 13 - Hollow Metal Doors and Frames
- .2 Section 08 71 00 - Door Hardware
- .3 Section 08 80 00 - Glazing
- .4 Section 08 90 00 - Louvres and Vents
- .5 Section 09 91 23 - Interior Painting

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
 - .2 ASTM E779-19, Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
 - .3 ASTM D6007-22, Standard Test Method for Determining Formaldehyde Concentrations in Air from Wood Products Using a Small-Scale Chamber
 - .4 ASTM E1333-22, Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates From Wood Products Using a Large Chamber
- .2 Architectural Woodwork Manufacturers Association of Canada / Woodwork Institute (AWMAC/WI):
 - .1 North American Architectural Woodwork Standards (NAAWS), 4.0
- .3 California Air Resources Board (CARB):
 - .1 [Airborne Toxic Control Measure \(ATCM\) to Reduce Formaldehyde Emissions from Composite Wood Products, current edition](#)
 - .2 2007 [Suggested Control Measure \(SCM\) for Architectural Coatings](#)
- .4 CSA Group (CSA):
 - .1 CSA A440.4:[19], Window, door, and skylight installation
 - .2 CAN/CSA O132.2 Series-[90], Wood Flush Doors
 - .3 CAN/CSA-O132.5-[M1992], Stile and Rail Wood Doors
- .5 Decorative Hardwoods Association (DHA):
 - .1 ANSI/HVPA HP 1 20204, American National Standard for Hardwood and Decorative Plywood
- .6 Environment and Climate Change Canada (ECCC):
 - .1 [S.C. 1999, c. 33, Canadian Environmental Protection Act, 1999](#)

- .7 Forest Stewardship Council (FSC):
 - .1 FSC-STD-01-001-V5-3, FSC Principles and Criteria for Forest Stewardship
- .8 Green Seal (GS):
 - .1 GS-11-21, Paints, Coatings, Stains, and Sealers
 - .2 GS-36-13, Adhesives for Commercial Use
- .9 National Fire Protection Association (NFPA):
 - .1 NFPA 80-2013, Standards for Fire Doors and Other Opening Protectives
- .10 Programme for the Endorsement of Forest Certification (PEFC Canada):
 - .1 PEFC CAN ST 1001:2025, Sustainable Forest Management
- .11 South Coast Air Quality Management District (SCAQMD):
 - .1 SCAQMD Rule 1113-2016, Architectural Coatings
 - .2 SCAQMD Rule 1168-2022, Adhesive and Sealant Applications
- .12 Sustainable Forestry Initiative (SFI):
 - .1 SFI-2022, Standards and Rules
- .13 Underwriters Laboratories (UL):
 - .1 UL 2761-2011, Standard for Sustainability for Sealants and Caulking Compounds
 - .2 UL 2762-2011, Standard for Sustainability for Adhesives
- .14 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S104-15, Standard Method for Fire Tests of Door Assemblies
 - .2 CAN/ULC-S105-16, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104
- .15 Window and Door Manufacturers Association (WDMA):
 - .1 ANSI/WDMA I.S. 1A-21, Interior Architectural Wood Flush Doors
 - .2 ANSI/WDMA I.S. 6A-13, Interior Architectural Wood Stile and Rail Doors

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate steel door frame dimensions and installation tolerances with Section 08 11 13 - Hollow Metal Doors and Frames.
 - .2 Coordinate door hardware with Section 08 71 00 - Door Hardware.
 - .3 Coordinate glass and glazing units with Section 08 80 00 - Glazing.
 - .4 Coordinate door louvres with Section 08 90 00 - Louvres and Vents.
- .2 Pre-installation meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by the Consultant and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review installation and substrate condition.
 - .4 Coordinate with other Subcontractors.
 - .5 Review manufacturer's instructions and warranty requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: Product literature and data sheets for each type of wood door, including product characteristics, performance criteria, physical sizes, finishes, and limitations.
 - .1 Submit WHMIS SDSs for:
 - .1 adhesives
 - .2 sealants
 - .3 coatings
 - .3 Shop drawings:
 - .1 Comply with NAAWS requirements.
 - .2 For each type of door include scaled details of components and indicate:
 - .1 Size of door.
 - .2 Core construction and thickness.
 - .3 Cut-outs and locations for lights and louvres.
 - .4 Swing direction.
 - .5 Undercut dimensions.
 - .6 Hardware location and preparation requirements.
 - .7 Blocking for hardware in mineral core doors.
 - .8 Fire-protection rating.
 - .9 Sound transmission class.
 - .10 Location of sealants.
 - .11 Location of manufacturer's nameplates.
 - .12 Glazing, if applicable.
 - .13 Types of finishes.
- .4 Samples:
 - .1 Submit three sets of finished wood veneer samples a minimum 300 mm × 300 mm of each wood species and cut of wood. Each sample set of three to represent the range of finish gloss level, colour, and wood grain proposed.
 - .2 Submit one plastic laminate sample, approximately 200 mm × 200 mm, for each colour/pattern required.
 - .3 Show door construction, faces, and core, representative of door types.
 - .4 Samples will not be returned.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance data:
 - .1 Include, in the operation and maintenance manual, manufacturer's [operating and] maintenance instructions and recommended cleaning materials and methods.
- .3 Warranty documentation: Submit manufacturer's material warranty.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturers/installers: Capable of providing specified warranty requirements.

- .2 Mock-ups: Erect in accordance with Section 01 43 00 - Quality Assurance.
 - .1 Mock-up to illustrate wood veneer, integration of hardware.
 - .2 Location: On site, as directed by the Consultant.
 - .3 Accepted mock-ups may remain as part of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements, and:
 - .1 Comply with NAAWS.
- .2 Delivery and acceptance requirements: Deliver materials to site in original factory packaging with manufacturer's labels. [Wrap] [Crate] doors.
- .3 Storage and handling requirements:
 - .1 Arrange for delivery after construction activities causing high humidity are completed.
 - .2 Unwrap and protect doors from scratches, handling marks, other damages, dampness and in accordance with manufacturer's recommendations [and CAN/CSA O132.2 Series, Appendix A].
 - .3 Store doors away from direct sunlight.

1.9 SITE CONDITIONS

- .1 Ambient conditions:
 - .1 Maintain optimum ambient conditions in accordance with NAAWS requirements.
- .2 Site measurements: Before fabrication, verify actual dimensions of openings by measuring on site, and indicate actual measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
- .3 Established dimensions: When site measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating doors without site measurements. Coordinate site construction to ensure that actual site dimensions correspond to established dimensions.

1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .2 Dispose of corrugated cardboard, polystyrene and plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.
 - .3 Unused or damaged glazing materials are not recyclable and must not be diverted to municipal recycling programs.
 - .4 Divert unused adhesive material from landfill to official hazardous material collections site approved by Consultant.
 - .5 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.
-

PART 2 PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- .1 Regulatory requirements:
 - .1 Fire-protection rated wood doors: Labelled and listed by an organization accredited by the Standards Council of Canada, having factory inspection services, in conformance with CAN/ULC S104 for ratings indicated. Fabricate as detailed in follow-up service procedures / factory inspection manuals issued by listing agency to the manufacturer.
 - .2 Fire-protection rated door frames: To CAN/ULC-S105.
 - .3 Affix appropriate labels to each required opening to indicate labelling requirement:
 - .1 At standard size openings: Fire endurance rating.

2.2 FIRE RATED WOOD DOORS

- .1 Wood doors: tested in accordance with CAN4-S104 to achieve rating as scheduled.
 - .1 Refer to Drawings for Ratings.
 - .2 Construction: Fire rated construction to provide ULC or Warnock-Hershey labels.
 - .3 Internal blocking: Provide blocking for all surface mounted hardware to AWMAC Option #3; Manufacturers' standard fire resistant blocking.
 - .4 Rails:
 - .1 Top 114.3mm minimum
 - .2 Bottom: 254mm minimum
 - .5 Stiles
 - .1 Hinge: 114.3mm minimum.
 - .2 Lock: 114.3mm minimum.
 - .6 Crossbanding: 1.5mm thick HDF composite
 - .7 Face Panels: Flat Slab, Maple veneer.
 - .1 Molded Wood Fiber Facing,
 - .1 Panel Pattern: Flat
 - .2 Surface Texture: Smooth

2.3 WOOD FLUSH DOORS

- .1 Solid core: to CAN/CSA-O132.2.1.
 - .1 Construction:
 - .1 Solid particleboard core: stile and rail frame bonded to particleboard core with wood lock blocks and special describe wood blocking, 5-ply construction.
 - .2 Solid wood core:
 - .1 Glued block core with wood edge band.
 - .2 Framed block glued core.
 - .3 Framed block nonglued core.
 - .4 Stile and rail core.
 - .5 5-ply construction.
 - .3 Face Panels:
 - .1 In accordance with AWS Section 4, based on veneer face grades established by HPVA, maple species, flat cut, random slip matched, Grade AA. Strong colour contrasts in the grain pattern or between flitches are unacceptable.
 - .4 Adhesive: Type II (water resistant) for interior doors.
- .2 Hollow core: to CAN/CSA-O132.2.1.
 - .1 Construction:
 - .1 Cellular core with lock blocks, 5-ply construction.

- .2 Face Panels:
 - .1 In accordance with AWS Section 4, based on veneer face grades established by HPVA, maple species, flat cut, random slip matched, Grade AA. Strong colour contrasts in the grain pattern or between flitches are unacceptable.
- .3 Adhesive: Type II (water resistant) for interior doors.

2.4 GLAZING

- .1 Glazing: Clear Single glass, tempered, in accordance with Section 08 80 00 - Glazing.

2.5 FABRICATION

- .1 Provide blocking for surface-mounted hardware to prevent need for through bolting.
- .2 Prepare sound resistant door bottom for installation of flush mount automatic door bottom seal.
- .3 Vertical edge profiles:
 - .1 Bevel vertical edges of single acting doors 3 mm in 50 mm on the lock side and 1.5 mm in 50 mm on the hinge side.
 - .2 Pair of doors meeting edges: Bevelled.
 - .3 At fire-rated doors: To NFPA 80.
- .4 Finish plastic laminate smooth and flush with stile edges of door, bevel at approximately 20 degrees.
- .5 Provide waterproof non-staining membrane at cut-outs on exterior doors to exclude moisture from core. Provide metal flashing at top edge of exterior out-swinging doors.
- .6 Factory-prepare holes 13 mm in diameter and larger except mounting and through-bolt holes, on site when installing hardware.
- .7 Provide fire labelled doors for openings requiring fire-protection ratings.
- .8 Manufacturer's nameplates on doors are not permitted. Nameplates on hinge edge are acceptable.
- .9 Sequence match, run and match vertically flush wood doors with [faces of wood veneer cabinet doors, drawer fronts, and false fronts] [adjacent wood veneer wall paneling].

2.6 FINISHES

- .1 Primer materials: Water-based primers are not acceptable.
- .2 Shop priming for doors with opaque finish:
 - .1 Before applying shop primer, steam out deep scratches and ease sharp edges by sanding.
 - .2 Shop prime doors with one coat of wood primer. Primer compatible with finish paint indicated in Section 09 91 23 - Interior Painting. Apply primer to all four door edges, to edges of cut-outs, and to mortises.
- .3 Shop finishing methods: Transparent finish for wood veneer wood doors.
 - .1 NAAWS grade: Premium Grade.
 - .2 NAAWS transparent finish system: Manufacturer's choice.
 - .3 Stain: As selected by the Consultant from manufacturer's samples.
 - .4 Gloss level: Satin.

2.7 ACCESSORIES

- .1 Glazing and louvre stops:
 - .1 Solid hardwood, mitred corners, flush moulding, species matching face veneer, transparent finish. Free of open defects, shake, splits, and doze.
 - .2 Steel, 1.0 mm metal core thickness, screw attached. Accurately fit and butt at corners glazing trim and stops, locate on secure side of door or facing interior of room.
 - .3 Provide 16 mm minimum stop height for factory-sealed double-glazed units.
 - .4 Provide special stops and stop adjusters for sound resistant glazed doors to maintain STC rating.
- .2 Fire labels: Metal, riveted.
- .3 Door hardware: In accordance with Section 08 71 00 - Door Hardware.
 - .1 Automatic door bottom seals: Type to achieve STC value specified.
 - .2 Perimeter sound gaskets: Adjustable, type to achieve STC value specified.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Verify door frames are plumb, square, level, and in plane.

3.2 INSTALLATION

- .1 Install fire-protection rated doors in accordance with NFPA 80.
- .2 Install doors in accordance with manufacturer's instructions and NAAWS Section 14, in accordance with grade specified.
- .3 Install glazing in accordance with Section 08 80 00 - Glazing.
- .4 Install louvres and stops specified in Section 08 90 00 - Louvres and Vents in accordance with manufacturer's instructions.
- .5 Install hardware in accordance with Section 08 71 00 - Door Hardware.
- .6 Tolerances: Provide even margins between door and jambs, and:
 - .1 Hinge side: 1.0 mm.
 - .2 Latch side and head: 1.5 mm.
 - .3 Finished floor, non-combustible sills and thresholds: Maximum 19 mm.

3.3 ADJUSTING

- .1 Adjust doors and hardware to function correctly, operate smoothly and easily, without binding. Adjust pairs of doors when closed within 1.6 mm of flush at the meeting edge.
 - .2 Fill and retouch minor nicks, chips, and scratches. Replace un-repairable damaged items.
 - .3 Repair damage to adjacent materials caused by wood doors installation.
-

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning, and:
 - .1 Clean doors after installation to remove dust, fingerprints, and pencil marks.
 - .2 Clean glass and glazing materials with non-abrasive cleaner.
- .2 Waste management:
- .3 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 04 05 00 - Common Work Results for Masonry
- .2 Section 09 21 16 - Gypsum Board Assemblies
- .3 Section 09 30 13 - Ceramic Tiling

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 ASTM A780/A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - .3 ASTM A1008/A1008M-13, 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
 - .4 ASTM A666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
 - .5 ASTM B221-20, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
- .2 National Fire Protection Association (NFPA):
 - .1 NFPA 80-2013, Fire Doors and Other Opening Protectives
- .3 Specialty Steel Industry of North America (SSINA):
 - .1 Special Finishes for Stainless Steel, current edition
- .4 ULC Standards (ULC):
 - .1 CAN/ULC-S104-15, Standard Method for Fire Tests of Door Assemblies

1.3 SECTION INCLUDES

- .1 Non-rated access doors in walls and partitions
- .2 Fire-protection rated access doors in walls and partitions
- .3 Non-rated access doors in ceilings
- .4 Fire-protection rated access doors in ceilings

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate installation of access doors and panels in walls and partitions with Section 04 05 00 - Common Work Results for Masonry.
 - .2 Coordinate framing dimensions and installation of access doors and panels in walls and partitions with Section [09 21 16 - Gypsum Board Assemblies.
 - .3 Coordinate installation of access doors and panels with Section 09 30 13 - Ceramic Tiling.

- .2 Pre-installation Meetings: Hold a meeting in accordance with Section 01 31 19 – Project Meetings:
 - .1 Attended by Contractor, Subcontractor responsible for this Section, mechanical Subcontractor, Consultant, and other Subcontractors affected by work of this Section.
 - .2 Agenda: Discuss locations and types of access doors and panels, and obtain Consultant's acceptance of doors and panels in prominent locations (e.g., feature ceilings, main reception area, feature staircase).

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product data for each type of access door and panel components. Indicate door designation, type and model, product characteristics, fabrication details, dimensions, latching and locking types, fire-protection rating and sound transmission class rating, and finishes.
 - .2 Submit WHMIS SDS.
- .3 Shop Drawings:
 - .1 Submit access door and panel schedule. Include types, specific room numbers, dimensions, latching and locking types.
- .4 Samples:
 - .1 Submit each type of unit for review and acceptance.
 - .2 Samples will be returned for inclusion into work
 - .3 Submit each type of hand entry access door and panel.
 - .4 Submit one 300 x 300-mm corner sample of each type of body entry door.
- .5 Manufacturers' Instructions: Submit manufacturer's installation instructions.
- .6 Sustainable Design Submittals:
 - .1 Sourcing of Raw Materials: For the entire Project, provide a minimum of 20 products from a minimum of 5 manufacturers with responsible extraction practices as follows:
 - .2 Low-Emitting Materials:
 - .1 Submit manufacturer's information indicating VOC emission limit in grams per litre (g/L).

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Supply two keys for each cylinder lock and ensure all access panels are keyed alike.
- .3 Warranty Documentation: Submit manufacturer's warranty.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer: Five years manufacturing access doors similar to those required for this Project. Obtain each type of access door and panel from a single manufacturer.
 - .2 Installers: Two years of experience installing access doors and panels of similar complexity and scope to that required for the Project.
 - .3 Testing Agencies: Provide fire-protection rated doors and panels manufactured under the label service program of a testing agency accredited by the Standards Council of Canada.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging with manufacturer's labels.
 - .1 Provide temporary protection during delivery and site storage to prevent distortion, surface damage, and rust.
 - .2 After arrival on site, immediately remove wet wrapping materials, inspect doors and panels for damage, and notify delivery company and supplier if damage is found.
 - .3 Minor damage may be repaired if refinished products match new work, and are acceptable to Consultant.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in a dry interior location away from direct sunlight, in a way that prevents sagging, bowing, or twisting, and in accordance with manufacturer's recommendations.
 - .2 Store and protect access doors and panels from nicks, scratches, distortion and rust.
 - .3 Apply a temporary protective coating or film to stainless steel finished surfaces. Leave protective coating/film in place until final cleaning of building.

1.9 SITE CONDITIONS

- .1 Site Measurements: Before fabrication, verify actual dimensions of openings by measuring on site, and indicate actual measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .2 Established Dimensions: When site measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating access doors and panels without site measurements. Coordinate site construction to ensure that actual site dimensions correspond to established dimensions.

1.10 WARRANTY

- .1 Manufacturer's Warranty: One year warranty, free from defects in material and manufacturing.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- .1 Rated Access Doors and Panels: At fire-resistance rated partition assemblies, provide access door and panel assemblies (comprising doors, frames, hardware and other components of the Closure) complying with CAN/ULC-S104 or NFPA 80 with a fire-protection rating to suit the surrounding assembly.
 - .1 Labelled and listed by UL, ULC, ITS Warnock Hersey, or other inspecting agency acceptable to authority having jurisdiction (AHJ). Affix appropriate label to each unit indicating the labelling requirement.

2.2 MATERIALS

- .1 Steel Sheet: To ASTM A1008/A1008M
- .2 Galvannealed Steel: To ASTM A653/A653M

- .3 Stainless Steel: To ASTM A666, Type 304
- .4 Aluminum: To ASTM B221, extruded aluminum alloy, 6063-T6

2.3 ACCESS DOORS – NON-RATED WALLS AND PARTITIONS

- .1 Mounting Type: Flush-mounted with only frame edge and door visible.
- .2 Clear Opening Size:
 - .1 For body entry: 600 x 600mm minimum.
 - .2 For hand entry: 300 x 300mm minimum.
- .3 Door
 - .1 Material:
 - .1 Steel, minimum 1.2mm thick, enamel paint, white colour.
 - .2 Door Corners: 90 degree corners.
 - .3 STC-Rated Assemblies: Acoustic insulation applied to rear of access door.
- .4 Frame:
 - .1 Material:
 - .1 Steel, minimum 1.6mm, same finish as door.
 - .2 STC-Rated Assemblies: Continuous gasket at frame perimeter to maintain STC value of wall/partition assembly.
 - .3 Expanded galvanized metal lath perimeter wings where installed in plaster, except veneer plaster.
- .5 Accessories:
 - .1 Hinges:
 - .1 Galvanized steel, concealed hinge, 175 degree swing.
 - .2 Hinge Location: To manufacturer's standard.
 - .2 Lock/Latch Devices:
 - .1 Flush, common slot screwdriver cam latch.

2.4 ACCESS DOORS – NON-RATED IN CEILINGS

- .1 Mounting Type: Flush-mounted.
 - .1 Clear Opening Size:
 - .1 For body entry: 600 x 600mm minimum.
 - .2 For hand entry: 300 x 300mm minimum.
 - .2 Door: Mineral fiber insulation core, insulated sandwich type construction, downward opening.
- .2 Door:
 - .1 Material:
 - .1 Steel, minimum 1.2mm thick, enamel paint, white colour.
 - .2 Door Corners: 90 degree corners
- .3 Frame:
 - .1 Steel, minimum 1.6mm thick, same finish as door.
- .4 Accessories:
 - .1 Hinge: Continuous steel hinge with pin. Automatic closing device.
 - .2 Lock: Self latching

2.5 ACCESS DOORS – FIRE-RATED IN CEILINGS

- .1 Mounting Type: Flush-mounted.
 - .1 Clear Opening Size:
 - .1 For body entry: 600 x 600mm minimum.
 - .2 For hand entry: 300 x 300mm minimum.
 - .2 Door: Mineral fiber insulation core, insulated sandwich type construction, downward opening.
- .2 Door:
 - .1 Material:
 - .1 Steel, minimum 0.91mm thick, enamel paint, white colour.
 - .2 Door Corners: 90 degree corners
- .3 Frame:
 - .1 Steel, minimum 1.5 mm thick, same finish as door.
- .4 Accessories:
 - .1 Hinge: Continuous steel hinge with pin.
 - .2 Automatic closing device.
 - .3 Lock: Self latching.
 - .1 Latch release device operable from inside of door.
 - .4 Anchors complying with requirements of applicable fire test.

2.6 ACCESS DOORS – FIRE-RATED IN WALLS AND PARTITIONS

- .1 Mounting Type: Flush-mounted with only frame edge and door visible
- .2 Clear Opening Size:
 - .1 For body entry: 600 x 600mm minimum.
 - .2 For hand entry: 300 x 300mm minimum.
- .3 Door:
 - .1 Material:
 - .1 Steel, minimum 0.91mm thick, enamel paint, white colour.
 - .2 Door Corners: 90 degree corners
- .4 Frame:
 - .1 Material:
 - .1 Steel, minimum 1.6mm, same finish as door.
- .5 Accessories:
 - .1 Hinges:
 - .1 Concealed spring hinge, 175 degree swing, removable hinge pin to allow removal of door panel from frame, with safety cable to secure door to frame.
 - .2 Lock/Latch Devices:
 - .1 Flush, common slot screwdriver cam latch

2.7 FABRICATION

- .1 Fabricate access doors and panel assembly as a single unit, ready for site installation.
- .2 Fabricate large units with sufficient quantity of latches to hold door flush with frame.
- .3 Fabricate units rigid with bracing and reinforcements as required to remain square and prevent sagging.

- .4 Fabricate visible surfaces flat and smooth without embossed or imprinted manufacturer's name. Grind visible welds smooth and blended.
- .5 Touch-up factory-applied coatings and galvanized surfaces where finish was removed during fabrication.
- .6 Locate label indicating manufacturer and model [and fire-protection rating] on rear of panel door or other concealed surface , to NFPA 80.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: Verify conditions of substrates previously installed are acceptable for access doors and panels installation, in accordance with manufacturer's instructions.
 - .1 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Installation: locate access doors within view of equipment and ensure equipment is accessible for operating, inspecting, adjusting, servicing without using special tools.
 - .1 Install access doors and panels permitting access to service valves, traps, dampers, cleanouts, and other mechanical, electrical and conveyor control items concealed by walls and partitions, and concealed above gypsum board and acoustic panel [and plaster] ceilings.
- .2 Install fire protection rated access doors and panels in fire rated partitions and ceilings, in accordance with NFPA 80.
- .3 Isolate steel and aluminum from direct contact with dissimilar metals, concrete, and masonry with isolation coating of alkali-resistant bituminous paint, epoxy, or other permanent non-corrosive material recommended by manufacturer.
- .4 Set frames square and in-plane with the substrate assembly, aligned with adjacent visible finishes. Securely attach to substrates.
- .5 Access Doors above Acoustic Panel Ceilings: Install unobtrusive identification locators, such as a small self-adhering circle on the acoustic panel.

3.3 ADJUSTING

- .1 Touch-up with factory-applied finishes if damaged during installation.
 - .2 Repair damage to zinc coatings in accordance with ASTM A780/A780M.
 - .3 Repair damage to adjacent materials caused by installation of access doors and panels.
 - .4 Adjust operable parts for correct function.
-

3.4 CLEANING

- .1 Progress and Final Cleaning: Perform in accordance with Section 01 74 00 - Cleaning and remove gypsum board compound from hinges, frames, and door edges.
- .2 Waste Management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 Aluminum Association (AA):
 - .1 AA DAF 45-03, Designation System for Aluminum Finishes
- .2 ASTM International (ASTM):
 - .1 ASTM A1008/A1008M-[13], 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
 - .2 ASTM D523-[14], Standard Test Method for Specular Gloss
 - .3 ASTM D822/D822M-[13], Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.105-M91, Quick-Drying Primer
 - .2 CAN/CGSB-1.213-04, Etch Primer (Pretreatment Coating or Tie Coat) for Steel and Aluminum
 - .3 CAN/CGSB-1.181-99, Ready-Mixed, Organic Zinc-Rich Coatings
- .4 CSA Group (CSA):
 - .1 CAN/CSA-G164-[18], Hot Dip Galvanizing of Irregularly Shaped Articles
- .5 Environmental Choice Program (ECP):
 - .1 CCD-016-[97], Thermal Insulation

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting 1 week before beginning work of this Section and on-site installation, with Contractor, Subcontractor, and Consultant in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other Subcontractors.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Submit manufacturer's instructions, product literature and data sheets for doors, hardware, operators, and accessories and include product characteristics, performance criteria, physical size, finishes, and limitations.
- .3 Shop Drawings: Indicate sizes, service rating, types, materials, operating mechanisms, glazing locations and details, hardware and accessories, required clearances [and electrical connections].
- .4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .5 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

- .6 Manufacturer Reports:
 - .1 Manufacturer's Site Reports: submit manufacturer's written reports within [3] days of review, verifying compliance of Work, as described in Part 3 - SITE QUALITY CONTROL.
- .7 Sustainable Design Submittals:
 - .1 Recycled Content: Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for the Project.
 - .2 Regional Materials: Submit evidence that project incorporates required percentage of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for the Project.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance data for sectional metal doors and incorporate into manual.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Spare parts:
 - .1 Supply spare parts for sectional metal doors as follows:
 - .1 Door rollers: 10x.
 - .2 Weatherstripping: 10 sets.
 - .3 Springs and cables: 10x.
 - .2 Identify each part and reference to appropriate door.

1.6 QUALITY ASSURANCE

- .1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, well-ventilated area.
 - .2 Store and protect sectional metal doors, hardware and accessories from nicks, scratches, and blemishes.
- .3 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 19 - Waste Management and Disposal.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MANUFACTURER

- .1 This specification is based on Heavy Duty Commercial Metal Sectional Doors as manufactured by Garex Garage Doors, Model GX-175.
- .2 Requests for substitutions will be considered in accordance with provisions of Section 01 25 00 "Substitution Procedures". Acceptance of alternative products is subject to the approval of the Consultant.
- .3 Acceptable Alternative Manufacturers
 - .1 Richards Wilcox, Model: T175
 - .2 Garaga, Model: G-2020

2.2 DESIGN CRITERIA

- .1 Design exterior door assembly to withstand wind load of 1 kPa with a maximum horizontal deflection of 1/240 of opening width.
- .2 Design door panel assemblies with thermal insulation factor 2.81 RSI.
- .3 Design door assembly to withstand minimum 20,000 cycles per year, and 20 years total life cycle.

2.3 MATERIALS

- .1 Galvanized steel sheet: commercial quality Z275 zinc coating.
- .2 Steel sheet: commercial quality to ASTM A1008/A1008M, exposed (E), with smooth finish.
- .3 Aluminum extrusions: Aluminum Association alloy AA6063-T5.
- .4 Primer: to CAN/CGSB-1.181, for galvanized steel surfaces.
- .5 Insulation: to meet design requirements and to CCD-016.
- .6 Glazing: Refer to Section 08 80 00.
- .7 Cable: multi-strand galvanized steel aircraft cable.

2.4 DOORS

- .1 Fabricate 45 mm thick insulated doors of interlocking steel sections as indicated.
 - .2 Fabricate panel frames in a continuous box frame with vertical stiffeners at 600 mm centres.
 - .3 Install glazing for door sections. Sizes and number of lights as indicated.
 - .4 Assemble components by means of spot or arc welding or coated rivet system or adhesive and self-tapping screws to manufacturer's recommendations.
 - .5 Apply shop coat of primer after fabrication of door.
-

2.5 HEAVY DUTY INDUSTRIAL HARDWARE

- .1 Track: high lift hardware with 75 mm size 2.66 mm core thickness galvanized steel track.
- .2 Track Supports: 2.3 mm core thickness continuous galvanized steel angle track supports.
- .3 Spring counter balance: heavy duty oil tempered torsion spring with manufacturers standard brackets.
 - .1 Drum: 200 mm diameter, die-cast aluminum.
 - .2 Shaft: 32 mm diameter galvanized steel.
- .4 Top roller carrier: galvanized Steel 3.04 mm thick adjustable.
- .5 Rollers: full floating grease packed hardened steel, ball bearing 75 mm diameter solid steel tire.
- .6 Roller brackets: adjustable, minimum 2.5 mm galvanized steel.
- .7 Hinges: heavy duty, 3.04 mm thick galvanized as recommended by manufacturer.
- .8 Cable: 6 mm diameter galvanized steel aircraft cable.

2.6 ACCESSORIES

- .1 Overhead horizontal track and operator supports: galvanized steel, type and size to suit installation.
- .2 Track guards: 5 mm thick formed sheet 1500 mm high track guards.
- .3 Pusher springs.
- .4 Weatherstripping:
 - .1 Sills: bulb type full width extruded neoprene weatherstrip.
 - .2 Jamb and head: extruded aluminum and arctic grade vinyl weatherstrip to manufacturer's standard.
- .5 Finish ferrous hardware items with minimum zinc coating of 300 g/m² to CAN/CSA-G164.

2.7 PREFINISHED STEEL SHEET

- .1 Prefinished steel with factory applied silicone modified polyester.
 - .1 Class F1S.
 - .2 Colour: Black or Iron Ore.
 - .3 Specular gloss: 30 units +/-5 in accordance with ASTM D523.
 - .4 Coating thickness: not less than 20 micrometres.
 - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822/D822M as follows:
 - .1 Outdoor exposure period 1000 hours.
 - .2 Humidity resistance exposure period 1000 hours.

2.8 OPERATORS

- .1 Equip doors for operation by:
 - .1 Electric Jack Shaft with Chain hoist override.
- .2 Cable fail safe device.
 - .1 Able to stop door immediately if cable breaks on door free fall. Braking capacity minimum 500 kg.

2.9 ELECTRICAL OPERATOR

- .1 Electrical Jack shaft side mounted type operator.
- .2 Electrical motors, controller units, remote pushbutton stations, relays and other electrical components: to CSA approval with CSA type enclosure.
- .3 Power supply: 600V, 3 phase, 60 Hz.
- .4 Controller units with integral motor reversing starter, solenoid operated brake, 3 heater elements for overload protection, including pushbuttons and control relays as applicable.
- .5 Control Devices:
 - .1 Remote pushbutton stations: surface mounted, with "OPEN-STOP-CLOSE" designations on pushbuttons in English.
 - .2 Remote transmitter.
 - .3 Photoelectric cell.
 - .4 Auto-close timer.
- .6 Safety switch: combination roll rubber with limit switches for full length of bottom rail of bottom section of door, to reverse door to open position when coming in contact with object on closing cycle.
- .7 For jack shaft operators:
 - .1 Provide floor level disconnect device to allow for manual operation in event of power failure.
 - .2 Equip Operator with:
 - .1 Electrical interlock switch to disconnect power to operator when in manual operation.
 - .2 Built-in chain hoist for manual operation in event of power failure.
- .8 Automatic illumination complete with time delay, self-extinguishing.
- .9 Door speed: 300 mm per second.
- .10 Control transformer: for 24 VAC control voltage.
- .11 Mounting brackets: galvanized steel, size and gauge to suit conditions.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: Verify conditions of substrates previously installed are acceptable for sectional metal doors installation in accordance with manufacturer's instructions.
 - .1 Inspect substrates in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install doors and hardware in accordance with manufacturer's instructions.
 - .2 Rigidly support rail and operator and secure to supporting structure.
 - .3 Touch-up steel doors with primer where galvanized finish damaged during fabrication.
-

- .4 Install operator including electrical motors, controller units, pushbutton stations, relays and other electrical equipment required for door operation.
- .5 Lubricate and adjust door operating components to ensure smooth opening and closing of doors.
- .6 Adjust weatherstripping to form a weather tight seal.
- .7 Adjust doors for smooth operation.

3.3 SITE QUALITY CONTROL

- .1 Manufacturer Services:
 - .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing and cleaning of product within 3 days of review.
 - .2 Submit manufacturer's site services consisting of periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Ensure manufacturer's representative is present before and during critical periods of installation construction of site joins and testing.
 - .4 Schedule site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove traces of primer; clean doors and frames.
 - .2 Clean glass and glazing materials with approved non-abrasive cleaner.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 07 21 19 - Polyurethane Foam Insulating Sealant.
- .2 Section 07 27 00 - Air Barriers and Waterproofing.
- .3 Section 07 92 00 - Joint Sealants.
- .4 Section 08 80 50 - Glazing.

1.2 REFERENCES

- .1 Aluminum Association (AA):
 - .1 AA-DAF-45-2003, Designation System for Aluminum Finishes.
- .2 Canadian Standards Association (CSA):
 - .1 CSA-A440-05, Windows.
 - .2 CSA-A440-00/A440.1-00, User Selection Guide to CSA-A440, Windows / Special Publication.
 - .3 CAN/CSA-G40.20-98, General Requirements for Rolled or Welded Structural Quality Steel.
 - .4 CSA-G40/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel.
 - .5 CAN3-S157/S157.1-05, Strength Design in Aluminum/ Commentary on CSA S157-05, Strength Design in Aluminum.
 - .6 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 Master Painters Institute (MPI):
 - .1 MPI Architectural Specification Manual, 2004 (referred to herein as "MPI Manual")
 - .2 MPI Approved Product List, January 2009 (Referred to herein as "MPI APL").
- .4 The Society for Protective Coatings (SSPC):
 - .1 SSPC-Paint 12 1982, Paint Specification No. 12: Cold Applied Asphalt Mastic (Extra Thick Film).

1.3 QUALIFICATIONS

- .1 The work of this Section shall be fabricated in the factory by a manufacturer with minimum ten (10) years experience in the actual production of the specified products and shipped to the site, k/d.
- .2 The work of this Section shall be installed by a company licensed by the material manufacturer as an approved installer.
- .3 Employ only skilled tradesmen who are experienced in this work.
- .4 If requested by the Consultant, provide evidence of previously completed projects of a similar nature.

1.4 SUBMITTALS

- .1 General: Submit each item in this Article according to the Conditions of the Contract and the applicable Division 01 Specification Sections.

- .2 Shop Drawings:
 - .1 Indicate materials and fully dimensioned details at a scale of no less than half full size for head, jamb and sill, profiles of components, interior and exterior trim, junction between combination units, fully dimensioned elevations of units, anchorage details, locations of isolation coating, description of related components and exposed finishes fasteners, and caulking. Indicate the locations of manufacturer's nameplates.
 - .2 Provide complete fabrication and installation details of custom exterior trim at window heads.
- .3 Test Reports: Submit test reports from independent testing laboratories, acceptable to the Consultant, certifying compliance with the specification requirements for:
 - .1 Finish.
 - .2 Air tightness.
 - .3 Water tightness.
 - .4 Wind load resistance, mullion deflection.
 - .5 Condensation resistance.
- .4 Samples:
 - .1 Submit a sample of a each type of window, reduced overall size but using actual sections, components and glass in specified finishes. Include a cutaway corner of each type of window.
 - .2 Samples to incorporate an representative example of each typical connection and each trim profile.
 - .3 Submit a full-size sample of a 300 mm long section of the exterior trim at the window heads. Include method of fastening and end caps. Use actual materials and finishes proposed for the work.
- .5 Post-installation certification: After installation, provide written certification, signed by the window manufacturer, that all items have been installed in accordance with the reviewed shop drawings to the satisfaction of the window manufacturer.
- .6 Maintenance Data:
 - .1 Provide maintenance data for incorporation into the building operation and maintenance manual.
 - .2 Include maintenance data for cleaning and maintenance of aluminum finishes.

1.5 PERFORMANCE

- .1 Structural performance shall be based on CAN3-S157 and a maximum deflection of 1/175 of the span.
- .2 Windows shall meet or exceed the following performance classification requirements of CSA Standard CAN/CSA-A440 Windows:
 - .1 Air infiltration:
 - .1 Fixed windows: FIXED
 - .2 Water infiltration: B7
 - .3 Wind load resistance: C5
 - .4 Condensation resistance temperature index:
 - .1 Fixed windows:
 - .1 I_f: 66
 - .2 I_g: 68
 - .2 Operable vents: 56.2 minimum.

- .3 The design shall allow for an ambient temperature range of -35°C to +35°C without causing buckling, stresses on glass, failure of seals, undue stress on structural elements, reduction of performance or other detrimental effects.

1.6 THERMAL MOVEMENT

- .1 Conduct a thermal analysis to determine the full range of shadow patterns and temperature conditions to which the glazing will be subjected after installation.
- .2 Coordinate frame and glass dimensions to ensure that adequate provision is made to provide for thermal movement of the glass.
- .3 Sealed thermal units which crack or break as a result of thermal stresses will be replaced, immediately, at no cost to the Owner.

1.7 WARRANTY

- .1 For the work of this Section, the 12-months warranty period prescribed in the General Conditions of the Contract, is extended to 10 years.

1.8 PROTECTION

- .1 Apply temporary protective coating to finished surfaces. Remove coating after erection. Do not use coatings that will become hard to remove or leave residue.
- .2 Leave protective covering in place until final cleaning of building.

1.9 STORAGE AND HANDLING

- .1 Store and handle materials in strict accordance with the manufacturer's recommendations.

PART 2 PRODUCTS

2.1 GENERAL

- .1 This specification is based on Aluminium windows as manufactured by Alumicor.
- .2 Requests for substitutions will be considered in accordance with provisions of Section 01 25 00 "Substitution Procedures". Acceptance of alternative products is subject to the approval of the Consultant.
- .3 Acceptable Alternative Manufacturers
 - .1 Commdoor, 525 Series
 - .2 Cahill Commercial, CA114RS

2.2 PRODUCTS

- .1 Alumicor, Model Rainblade 1970.
 - .1 Mullion: 19mm x 158.8mm
 - .2 Nose: 50.8mm

- .2 Performance Requirements:
 - .1 Ensure system is designed to accommodate the following without damage to components or deterioration of seals:
 - .1 Thermal Resistance of:
 - .1 System U-Value: 0.45 maximum.

2.3 MATERIALS

- .1 Extrusions shall be 6063 T5 alloy and temper, thermally broken, minimum wall thickness 3 mm (1/8"). Main frame members to be 127 mm deep.
- .2 Formed aluminum components shall be of alloy and temper suitable for their purpose and finish.
- .3 Thermal Break separator: Extruded rigid virgin polyvinyl chloride, interlocked between inner and outer frames.
- .4 Aluminum sheet: Aluminum Association 5005-H34 alloy and temper:
 - .1 Exposed to sight: Anodizing quality.
 - .2 Not exposed to sight: Utility grade.
- .5 Fasteners shall be 300 series stainless steel or 400 series stainless steel cadmium plated and of sufficient size and quantity to perform their intended function.
- .6 Provide aluminum sills, minimum 3 mm thick extrusions, profile to suit, c/w jamb drip deflectors and concealed fastening, finish to match windows.
- .7 Glass as specified in Section 08 80 50 "Glazing".
- .8 Glazing materials:
 - .1 Glazing gaskets shall be extruded, black, closed cell or dense elastomer of durometer appropriate to the function.
 - .2 Glazing tapes shall be macro-polyisobutylene, highly adhesive and elastic with continuous built-in shim.
- .9 Weatherstripping: Manufacturer's standard for each application. Double weather-strip operable window units at all sash perimeters. Install all weather-stripping in specially extruded ports and secure to prevent shrinkage or movement.
- .10 Hardware: Manufacturer's standard. For each vent, provide the following:
 - .1 Pair of hinges designed to permit cleaning of the outside surface of the window from the suite interior.
 - .2 Remote roto-operator to enable high level windows to be operated from floor level.
 - .3 Remote latching device that can be engaged and released from floor level.
- .11 Galvanized steel flashings: ASTM A446, minimum 28 gage (0.38 mm thick).
- .12 Joint sealants: Butyl as recommended by the window manufacturer.
- .13 Zinc-rich coating: MPI APL #19.
- .14 Isolation coating: alkali resistant bituminous paint to SSPC Paint-12.

2.4 FINISHES

- .1 Finish exterior aluminum surfaces with electrolytically deposited, Black anodic finish, designation AA-M10-C21-A41, Architectural Class I, in accordance with Aluminum Association Designation System for Aluminum Finishes.
- .2 Finish interior aluminum surfaces with electrolytically deposited, Black anodic finish, designation AA-M10-C21-A41, Architectural Class I, in accordance with Aluminum Association Designation System for Aluminum Finishes.
- .3 Steel clips and reinforcement: 380 g/m² zinc coating to ASTM A123.
- .4 Isolate aluminum from the following components by a heavy coating of bituminous coating:
 - .1 Dissimilar metals except stainless steel, zinc or white bronze in small area.
 - .2 Concrete, mortar and masonry.
 - .3 Wood.

2.5 FABRICATION

- .1 Fabricate framing from extrusions of size and shape shown on the reviewed shop drawings.
- .2 Framing shall be two part construction integrated with a glass-reinforced nylon thermal break to form a rigid composite assembly without the use of fasteners or other thermal bridging elements.
- .3 The composite frame assembly shall have a minimum resistance to shear between the aluminum and the thermal break materials of 4815 N/100 mm.
- .4 Dry shrinkage of the thermal break shall not exceed 0.10% of the framing member length.
- .5 Fixed framing shall be designed for screw spline corner construction. Operating vent sash extrusions shall be tubular with mitred, clip, adhesive, stake joint construction.
- .6 All framing joints shall be accurately machined to allow site assembly and sealing, providing neat weathertight connections.
- .7 Glass stops shall be lock-in screwless type.
- .8 Fabricate units square and true with maximum tolerance of plus or minus 1.5 mm for units with a diagonal measurement of 1800 mm or less and plus or minus 3 mm for units with a diagonal measurement over 1800 mm.
- .9 All glazing pockets shall be vented, pressure equalized and drained to the exterior.
- .10 An elastomeric air-seal gasket shall be installed around the full perimeter of the glass and seated at corners with silicone sealant, properly adhered to the air seal gasket.
- .11 Brace frames to maintain squareness and rigidity during shipment and installation.
- .12 Provide structural anchors with an allowance for adjustment and welded after final window unit alignment. Touch-up with zinc-rich coating immediately following the alignment and fastening operation.
- .13 Glaze windows in accordance with the manufacturer's recommendations.

2.6 ISOLATION COATING

- .1 High build bituminous paint, SSPC Paint 12.
- .2 Isolate aluminum from the following components by means of isolation coating:
 - .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
 - .2 Concrete, mortar and masonry.
 - .3 Wood.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Examine areas and conditions under which the work is to be performed and notify the Consultant in writing of conditions detrimental to the proper and timely completion of the work.
- .2 Do not proceed with the work until unsatisfactory conditions have been corrected to the satisfaction of the installer.
- .3 Take field measurements to verify or supplement dimensions.
- .4 Commencement of the installation will be construed as acceptance of the site conditions and, thereafter, the Contractor shall be fully responsible for satisfactory work as specified herein.

3.2 COORDINATION AND PREPARATION

- .1 Anchorage Inserts: Coordinate with the concrete installer and ensure that inserts for anchorage which are required to be installed by that trade are supplied by this Section at the appropriate time in the construction schedule.

3.3 INSTALLATION

- .1 Install the windows in accordance with the manufacturer's instructions and the reviewed shop drawings.
- .2 Arrange components to prevent abrupt variation in colour.
- .3 Set all frames and glazing material in their proper location, level, square, plumb, at proper elevations and in proper alignment with other work.
- .4 Fasten securely.
- .5 Touch-up field welds and anchoring brackets with 2 coats of zinc-rich paint. Surfaces must be clean, free of grease, paint, mill scale and rust prior to application of touch-up.

3.4 INSULATING SEAL

- .1 Fill all voids with urethane foam insulating sealant. Refer to Section 07 21 19.

3.5 CAULKING

- .1 Seal the perimeter of the window frame against adjacent materials on the interior and exterior.

- .2 Apply sealant in accordance with Section 07 92 00 "Joint Sealants". Conceal sealant within the window units except where exposed use is permitted by the Consultant. Colour of exposed sealant to match finish.

3.6 PROTECTION

- .1 During and after installation protect the work of this Section from damage. Remove all corrosive or foreign material or droppings resulting from the work of this or other trades. Make good damage.

3.7 CLEANING

- .1 Upon completion of the installation, remove from the premises all surplus material, dirt and debris caused by the work of this Section and leave the installation clean.
- .2 Clean any drippage and spills of surplus sealant from adjacent surfaces.
- .3 Make good any damage caused by the work of this Section.
- .4 Just before Contract Closeout, or when directed by the Consultant, remove protective coating and clean all surfaces, using materials and methods recommended by the window manufacturer.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

- .1 Supply only of hardware for:
 - .1 Section 08 11 14 - Metal Doors and Frames
 - .2 Section 08 36 13.02 – Insulated Metal Section Door
 - .3 Section 26 00 00 - Electrical

1.2 REFERENCE STANDARDS

- .1 Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturer's Association, or as indicated for special conditions.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

- .1 Use hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 All fire and life safety codes shall be met as required by the authority having jurisdiction.
- .3 Use lock and latch sets with lever handles meeting requirements of CAN/CSA-B651-04, Barrier Free Design, unless specified otherwise.

1.4 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheets indicating hardware proposed, including ANSI function where ANSI used in this specification, grade, type, series, BHMA finish, fire label listing, in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Samples:
 - .1 Submit samples of each type of hardware specified in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
 - .3 After approval samples will be returned for incorporation in the Work.
- .3 Hardware List:
 - .1 Submit a typewritten Finishing Hardware schedule in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Indicate specified hardware, including make, model, base material, function, size, finish and other pertinent information.
- .4 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide operation, maintenance data, parts list and manufacturer's instructions for each type of locksets, fire exit hardware, door closers and door holders for incorporation into manual specified in 01 78 00 – Closeout Submittals.

1.6 HARDWARE LIST

- .1 When preparing the Finishing Hardware schedule to submit for approval, it is the Door Hardware Supplier's responsibility to review specifications and drawings, Confirming quantities and detailing, reporting any errors and/or omissions to the Consultant. "Extras" will not be considered nor accepted for necessary changes as a result of the Door Hardware Supplier's neglect.
- .2 "Extras" will be invoiced at no more than 30% off Manufacturer's current list price. "Credits" will be issued at no less than 70% off Manufacturer's current list price.
- .3 Submit six (6) copies of a typewritten Finishing Hardware schedule complete with catalogue cuts for approval by the Consultant prior to the ordering of any materials.
- .4 Clearly identify hardware listed by manufacturers name, product catalogue number and finish.
- .5 Upon receipt of approved schedule, issue six (6) copies to the General Contractor for the various subtrades.

1.7 MAINTENANCE MATERIALS SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 00 10 – General Instructions
- .2 Tools:
 - .1 Supply two sets of wrenches for locksets, exit devices and door closers.

1.8 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Use hardware for doors in fire separations and exit doors certified by a Canadian Certification organization accredited by Standards Council of Canada.
 - .2 All fire and life safety codes shall be met as required by the authority having jurisdiction.
 - .3 Use lock and latchsets with lever handles meeting requirements of CAN/CSA- B651, Barrier Free Design, unless specified otherwise.
- .2 Pre-installation Meetings:
 - .1 Conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
 - .2 Attend site meetings as requested by the Contractor.
- .3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.9 DELIVERY, PACKAGING AND STORAGE

- .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 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .4 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 door hardware from nicks, scratches, and blemishes.
 - .3 Protect prefinished surfaces with wrapping, strippable coating.
 - .4 Replace defective or damaged materials with new.

1.10 GUARANTEE

- .1 All hardware supplied under the approved hardware schedule will be guaranteed by the Manufacturer for a period of two (2) year after final acceptance of the project. Door closers will be guaranteed for five (5) years. Operators to be guaranteed for a period of two (2) years.

1.11 FASTENINGS

- .1 All hardware is to be installed using manufacturers' supplied fasteners. Failure to comply may void warranties and applicable licensed labels. Self-tapping/tek screws will not be acceptable on this project.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for proper installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.
- .4 Push and kick plates shall be supplied with self-adhesive tape unless specified otherwise than supply countersunk flat head, oval head socket screws to suit door material.

1.12 KEYING

- .1 All temporary Schlage construction use cylinders are to be supplied keyed alike or different as required.
- .2 Supply twelve (12) Schlage change keys for each keyed alike group of temporary construction use Schlage cylinders.
- .3 All permanent Medeco cylinders and keys are to be supplied and installed by the Client Locksmith.
- .4 The Door Hardware Supplier is to ensure all temporary cylinders are supplied with cams/tailpieces suitable for specified lock functions. Supply all compression rings, trim collars and blocking rings to suit.
- .5 The Contractor is responsible for providing locks and cylinders as required for his own use during the period of construction.

1.13 FINISHES

- .1 Hinges:
 - .1 628 clear anodized aluminum
 - .2 630 stainless steel metal, satin
 - .3 652 satin chromium plating on steel
- .2 Concealed Hinges
 - .1 BSP Matte Black
- .3 Locksets
 - .1 622 Matte Black
 - .2 626 satin chromium plated
- .4 Cylinders
 - .1 626 satin chromium plated
- .5 Exit Devices
 - .1 630 Satin Stainless Steel
 - .2 711 Black
- .6 Electric Strikes
 - .1 630 stainless steel, satin
- .7 Door Pulls
 - .1 630 stainless steel, satin
- .8 Door Closers
 - .1 622 Matte Black
 - .2 689 powder coat aluminum
- .9 Door Operators
 - .1 BSP Black Suede Powder Coat
 - .2 689 powder coat aluminum
- .10 Protection Plates
 - .1 630 stainless steel, satin
- .11 O/H Stops & Holders
 - .1 630 stainless steel, satin
- .12 Floor & Wall Stops
 - .1 626 satin chromium
- .13 Auto Door Bottoms
 - .1 AA Clear Anodized Aluminum
- .14 Threshold:
 - .1 AL clear anodized aluminum
- .15 W/Stripping
 - .1 AL clear anodized aluminum

1.14 ABBREVIATIONS

.1	ALD	aluminum door
.2	ALF	aluminum frame
.3	HMD	hollow metal door
.4	INS. HMD	insulated hollow metal door
.5	PSF	pressed steel frame
.6	SCWD	solid core wood door
.7	LH	left hand
.8	RH	right hand
.9	LHR	left hand reverse
.10	RHR	right hand reverse
.11	MS	machine screw
.12	HR/FR	hour/fire rated
.13	MIN/FR	minute fire rated
.14	TB	through bolted
.15	L.T.S.	length to suit
.16	T.B.C.	to be confirmed

PART 2 PRODUCTS

2.1 HINGES

- .1 Butts and hinges:
 - .1 Hinges shall comply with ANSI/BHMA A156.1, All steel base, Full mortise, Five knuckle standard weight ball bearing, with Non Removable Pin.
 - .2 Supply 1-1/2 pair per door leaf for doors up to 2285mm in height. Supply one additional hinge for each additional 762mm of height or fraction thereof. Doors, 45mm thickness, up to 914mm in width, supply 114mm high hinges; over 914mm to 1220mm, supply 127mm high hinges.
- .2 Acceptable Manufacturers:
 - .1 PBB Inc. Model BB81.
 - .2 Hager Co. Model BB1279.
 - .3 McKinney. Model: TA2714
 - .4 Dorex, Model: BB1068

2.2 CONTINUOUS HINGES

- .1 Full mortise, heavy duty, no inset, minimum thirty-two thrust bearings, staggered screw holes. Length to match door height. 12.7mm of door heel exposure is acceptable and recommended to be sure the moving hinge leaf does not extend below the door.
 - .1 Acceptable Manufacturers:
 - .1 Hager Co., Model: Roton 780-112 HD
 - .2 McKinney, Model: MCK-12HD
 - .3 IVES, Model: XY Series

2.3 LOCKSETS

- .1 Mortise Locks shall comply with ANSI/BHMA A156.13, Heavy duty mortise type. Series 1000, grade 1. Lever design to have flat face (117mm long), 63.5mm overall projection, with end returning to 13mm from face of door. Provide dust boxes behind all strikes. Functions as specified.
 - .1 Acceptable Manufacturers:
 - .1 Schlage, Model: L-Series
 - .2 Sargent, Model: 8200 Series
 - .3 Dorex, Model: DM Series

2.4 DEADBOLT

- .1 Deadbolt shall comply with ANSI/BHMA A156.40, Series 2000, Grade 2. Provide Deadbolts with cylinders with smart key re-key technology. Finish to ANSI/BHMA #619. Functions as specified.
 - .1 Acceptable Materials:
 - .1 Schlage, Model: B500 Series
 - .2 Sargent, Model: 460 Series
 - .3 Dorex, Model: TLA Series

2.5 EXIT DEVICES

- .1 Rim Exit devices:
 - .1 Shall comply with ANSI/BHMA A156.3, type Rim lock, function field selectable, grade 1, conventional design. Lever design to have flat face (117mm long), 63.5mm overall projection, with end returning to 13mm from face of door. Finished to BHMA #626. Functions as specified.
 - .2 Acceptable Manufacturers:
 - .1 Von Duprin: Model 9875 Series
 - .2 Sargent: Model 8900 Series
 - .3 Dorex, Model: DX1 Series
- .2 Narrow Stile Rim Exit devices:
 - .1 Shall comply with ANSI/BHMA A156.3, function field selectable, grade 1, conventional design. Lever design to have flat face (117mm long), 63.5mm overall projection, with end returning to 13mm from face of door. Finished to BHMA #626. Functions as specified.
 - .2 Acceptable Manufacturers:
 - .1 Von Duprin, Model: 35 Series
 - .2 Sargent, Model: 8400 Series
 - .3 Dorex, Model: DX2 Series

2.6 ELECTRIC STRIKE (UNIVERSAL WASHROOM ONLY)

- .1 Electric Strikes shall comply with ANSI/BHMA A156.31. Heavy Duty all stainless steel construction. Adjustable strike box to compensate for any misalignment of the door or frame. Power Supply: 24V
 - .1 Fail Safe
 - .2 Fail Secure
- .2 Acceptable Manufacturer:
 - .1 Von Duprin, Model: 6300 Series
 - .2 Assa Abloy, Model: HES 9600 Series
 - .3 DormaKaba, Model: RCI 0163/0164

2.7 DOOR CLOSERS

- .1 Door Closers shall comply with ANSI/BHMA A156.4, Heavy duty. Full rack and pinion hydraulic action. Cast iron cylinder body. Adjustable spring power and back check. Size in accordance with ANSI/BHMA A156.4, table A1. Supply any adaptor plates required to facilitate installation.
 - .1 DEL - delayed action
 - .2 EDA - extra duty parallel arm
 - .3 LPA - less parallel arm
 - .4 H/O - hold open arm
- .2 Acceptable Manufacturers:
 - .1 Allegion, Model: LCN 4040XP
 - .2 Assa Abloy, Model: Sargent 281 Series
 - .3 Dorex, Model: 441HD Series

2.8 AUTOMATIC SWING DOOR OPERATORS

- .1 Coordinate the work of all trades, including glass and glazing, masonry, and electrical requirements covered in manufacturer's details and appropriate sections of the specification.
- .2 Operators shall open the door with a 1/8 HP motor through reduction gears, door arm, and linkage assembly, as follows
 - .1 Low energy operator or full power, door opening time: not be less than five (5) seconds.
 - .2 The drive train shall have a positive, constant engagement. The operator shall stop the door in the open position by electrically reducing the motor voltage and stalling against a 90° stop.
 - .3 Close the door by spring energy; controlled by employing the motor as a dynamic brake.
 - .4 Door closing time shall not be less than five (5) seconds.
 - .5 Pre-load closing spring for positive closing action at a low material stress level for long spring life.
 - .6 Provide obstruction detection to reverse door when closing if an object stops the door and to stop door from opening if object is detected on swing side.
 - .7 The operator shall function as a manual door closer in the direction of swing with or without electrical power.
- .3 The door forces and speeds generated during power opening and manual opening in both directions of swing and spring closing in both directions of swing shall conform to the requirements of ANSI A156.10 or A156.19.
- .4 Actuators:
 - .1 4-1/2" x 4-1/2" Barrier Free Automatic Door Operator Switches with Universal symbol of accessibility
 - .2 Acceptable Manufacturer: Camden Door Controls, Model: CM-45/2

- .5 Acceptable Manufacturers:
 - .1 Dormakaba, Model: ED100
 - .2 Micom, Model: SW800
 - .3 Farron, Model: FA-85C

2.9 UNIVERSAL RESTROOM CONTROLS KITS

- .1 Performance:
 - .1 Automatic door controls shall comply with Americans with Disability Act.
 - .1 Regulatory compliance with Accessibility Guidelines (ADAAG) and the Uniform Federal Accessibility Standard (UFAS) as required by Authority Having Jurisdiction (AHJ).
 - .2 Automatic door controls shall comply with Ontario Building Code.
 - .3 Automatic door controls shall comply with NFPA National Fire Code or International Fire Code for restroom doors acting as egress doors as required by Authority Having Jurisdiction (AHJ).
- .4 Barrier Free Restroom Control Kit:
 - .1 Advanced Logic Control Relay & Power Supply Cabinet.
 - .1 Basis of Design: Camden Controls, Model: CX-33PS.
 - .2 Activation Devices:
 - .1 Exterior:
 - .1 Flush Mounted 4½" Square push plate (Wheelchair Symbol & Push to Open), with Illuminated Enclosure with English double sided sign: 'Door Locked when Red / Unlocked when Green' and 'Occupied when Red / Vacant when Green'.
 - .1 Basis of Design: Camden Controls, Model: CM-45/455SE1
 - .2 Interior:
 - .1 Flush Mounted 4½" Square 'Push to Lock' push plate with Illuminated Enclosure and English double sided sign: 'Door Locked when Red / Unlocked when Green' and 'Occupied when Red / Vacant when Green'.
 - .1 Basis of Design: Camden Controls, Model: CM-45/8B55SE1
 - .2 Flush Mounted 4½" Push Plate (Wheelchair Symbol & Push to Open), with English signs.
 - .1 Basis of Design: Camden Controls, Model: CM-45/4
 - .3 Surface mounted SPST N/C Magnetic Door Contact.
 - .1 Basis of Design: Camden Controls, Model: CX-MDA.
- .5 Emergency Call System Kit:
 - .1 Call Button:
 - .1 Ribbon switch, 33.5" vertical, "Press For Emergency Assistance" red lettering on white background.
 - .1 Basis of Design: Camden Controls, Model: 60-68B010
 - .2 Latching Relay:
 - .1 24V Latching Relay Assembly for EM Call System using momentary 'Press For Emergency Assistance' switches;
 - .1 Basis of Design: Camden Controls, Model: CX-LRS24
 - .3 Reset Switch:
 - .1 Vandal Resistant 1" Red Push Button, Single Gang Alum., N/C Momentary;
 - .1 Basis of Design: Camden Controls, Model: CM-8010R/13
 - .4 Sounder:
 - .1 Single gang, LED annunciator with adjustable sounder, 'ASSISTANCE REQUESTED'.
 - .1 Basis of Design: Camden Controls, Model CM-AF501SO
 - .5 Dome Sounder:
 - .1 Single Gang LED Dome Light, with Sounder

- .1 Basis of Design: Camden Controls, Model: CM-AF141SO.
- .6 Emergency Call System Occupant Instructional Sign.
 - .1 Basis of Design:
 - .1 English: Camden Controls, Model: CM-SE21.

2.10 PROTECTION PLATES

- .1 1.27mm (0.050") thickness type 304 stainless steel. To be drilled and countersunk where noted screw fasteners. Height: 305mm x length of door - minus 25mm each side. Confirm noted plate lengths suitable before ordering.
- .2 Acceptable Materials:
 - .1 Standard Metal, Model: K10A
 - .2 C.B.H., Model: 903
 - .3 Hager, Model: 190S csk
 - .4 Gallery, Model: 80A

2.11 PUSH PLATES

- .1 1.27mm (0.050") thickness type 304 stainless steel. To be drilled and countersunk where noted screw fasteners. Height as noted x length to suit. Confirm noted plate lengths suitable before ordering.
- .2 Acceptable Materials:
 - .1 Standard Metal, Model: K11A
 - .2 C.B.H., Model: 923
 - .3 Hager, Model: 30S
 - .4 Gallery, Model: GSH-81

2.12 DOOR PULLS

- .1 25.4mm round diameter, "D" shape, 90 degree offset, 304.8mm centres. Type 304 stainless steel.
 - .1 Acceptable Manufactures:
 - .1 Standard Metal, Model: 3012-2
 - .2 Gallery, Model: 1180-2
 - .3 C.B.H., Model: 7009-1"

2.13 O/H STOPS

- .1 Glynn-Johnson heavy duty overhead concealed "100" series and surface "90" series.
- .2 All listed degrees of hold open should be reviewed and confirmed before preparation and/or installation.
- .3 Function Options:
 - .1 H/O - Hold Open
- .4 Acceptable Materials:
 - .1 Glynn-Johnson, Model: 100 Series
 - .2 Sargent, Model: 690 Series
 - .3 Dorma, Model: 900 Series

2.14 WALL STOPS

- .1 Cast brass/bronze material except where specified zinc die cast. Rise to suit door undercut.
- .2 Wall stops shall have a metal backplate secured to wall with (2) screws and shields. Housing and rubber insert fits over backplate and is secured with inconspicuous set screw. No screws or holes shall be visible on face of bumper.
- .3 Acceptable Manufacturers:
 - .1 Standard Metal, Model: S122
 - .2 Gallery, Model GSH 250
 - .3 Ives, Model: WS401

2.15 THRESHOLD

- .1 Thermally Broken Extruded Aluminum. Slope and height to meet barrier free accessible requirements. Width to suit jamb and floor conditions. Oversized in length to allow coping around pressed steel frame faces.
- .2 Acceptable Manufacturers:
 - .1 Zero International
 - .2 Hager Companies
 - .3 Draftseal

2.16 AUTOMATIC DOOR BOTTOMS

- .1 Heavy duty mortise type. Provide end caps where open ends of door bottoms are exposed. No visible preps in either door edges, exception trigger mechanism. Insert to suit floor material.
- .2 Acceptable Manufacturers:
 - .1 Zero International: Wood: 360, Metal: 355
 - .2 Hager Companies: Wood: 730S, Metal: 742S
 - .3 Draftseal: Wood: DS386, Metal: DS344

2.17 DOOR SWEEP

- .1 Aluminum extrusion c/w silicone seal insert. Applied to bottom exterior face of door. Predrilled with oblong screw holes for adjustment. Less cUL sticker where noted.
- .2 Acceptable Manufacturers:
 - .1 Zero International
 - .2 Hager Companies
 - .3 Draftseal

2.18 DOOR SILENCERS - METAL

- .1 Silencers shall comply with ANSI/BHMA 156.16, L03011, made from 60 Durometer styrene butadiene rubber.
- .2 Acceptable Manufacturers:
 - .1 IVES
 - .2 Hager Companies
 - .3 KN Crowder Mfg. inc.
 - .4 Pemko, Assa Abloy

2.19 WEATHERSTRIPPING

- .1 Extruded aluminum with silicone insert. Predrilled with oblong screw holes for adjustment. Designed to provide continuous weather seal at head and jambs. Surface hardware to be attached to frame through weather-strip section. Confirm frame stop width sufficient to support 38.1±mm wide extrusion. Provide shim as required.
- .2 Extruded aluminum with silicone inserts. Predrilled with oblong screw holes for adjustment. Screw attachment does not interfere with silicone.
- .3 Acceptable Manufacturers:
 - .1 Zero International
 - .2 Hager Companies
 - .3 Draftseal

2.20 SMOKE GASKET

- .1 Perimeter seal consists of tear drop shaped 12.7mm wide x 6.35mm self-adhesive silicone.

2.21 SOUNDTRAP & STRIPPING

- .1 Fully adjustable Head and Jamb seals consisting of Solid Neoprene gasket. Height x length to suit door and frame size.
- .2 Acceptable Manufacturers:
 - .1 Zero International, Model: 188S
 - .2 Hager Companies, Model: 738
 - .3 Draftseal, Model: DSS11

2.22 DOOR LOUVER

- .1 Material:
 - .1 18 Gauge Galvanneal Steel Frame
 - .2 20 Gauge steel inverted "Y" Blades
- .2 Size: 305 x 610
- .3 Finish: Black Anodized
- .4 Acceptable Manufacturer.
 - .1 Rockwood, Model: LV-IY
 - .2 K.N. Crowder, Model: SDL-V90
 - .3 Draft Seal, Model: 800 A1

PART 3 EXECUTION

3.1 INSTALLATION

- .1 When requested, furnish metal door and frame manufacturer with complete instructions and templates for preparation of their work to receive hardware.

- .2 Only tradesmen competent in the installation of Finishing Hardware shall be used for this purpose. Qualification would require a minimum (5) years' experience in commercial application. The installer shall adjust, clean and make good all installation of Finishing Hardware to the satisfaction of the Consultant.
- .3 The Contractor is responsible for ensuring the door preps for cylinder holes are where required and are aligned properly with mortise locks. The Contractor is to use his own "try-out" cylinders prior to the Owner beginning installation of the permanent cylinders. Any holes found to be misaligned will be rectified by the Contractor.
- .4 Section 26 (Electrical) to provide backboxes, conduits c/w pull wires and power supply for all access control systems and related hardware.
- .5 Section 26 (Electrical) to provide 120V AC receptacles for control boxes. Section 26 to provide and install conduit/pull wire for air tubing and low voltage wiring from control boxes to openers and actuators. Recessed electrical boxes for actuators to be supplied and installed by Electrical. Install all door hardware for operation of door openers at not more than 1200mm and not less than 900mm centre line above the finished floor as per the O.B.C.. The Door Hardware Supplier is responsible for the installation of the door openers and all related hardware. The certified installer is to be approved by the manufacturer as having qualifications to ensure the proper operation of all components related to the opener systems.
- .6 Wiring schematics detailing all electrical components for each opening to be prepared by the hardware manufacturer at the request and with the support of the Door Hardware Supplier.
- .7 Kick plates are to be installed 1.59mm maximum up from the bottom edge of door on single doors install in centre of the door equally spaced to clear between the frame jamb stops.
- .8 Contractor to ensure walls are properly blocked to prevent future damage wherever surface mounted hardware i.e. wall stops are to be used.
- .9 Thresholds are to be extended from masonry opening to masonry opening and are to be coped around the pressed steel frames. Installer to caulk threshold base to ensure proper seal.
- .10 Gasketing is not to be installed until final coat of paint has been applied to the door and frame and is completely dry.
- .11 Door Supplier, when templating, must consider surface mounted w/stripping W-20S which is 7.9mm thick. Exit device strikes, door closer parallel arm brackets and overhead stop/holder brackets will mount on top of the weather-stripping.

3.2 INSPECTIONS

- .1 A Hardware Specialist engaged by the General Contractor shall make periodic site inspections during installation of hardware to ensure that all hardware supplied is being applied in accordance with specifications, details and Consultant's directions. Inform the Contractor and the Consultant in writing of such inspections, pointing out errors, omissions, etc.; so that they may be corrected.
- .2 Final inspection to be carried out by the Hardware Specialist when all hardware has been installed, to ensure that all hardware components (Door Stops, Door Closures, Door Sweeps, Gaskets, Astragals, Latches Access Controlled Door, etc.) work as a total system and operate as per Industry Standards. Representative to provide written certification that hardware has been installed and adjusted as intended.

- .3 The Criteria for Acceptance includes, but not limited to the following:
 - .1 Door Closes from any position in its swing, including from a position resting on the latch.
 - .2 All Door Pins Fit Securely in all receptacles.
 - .3 No excessive play of latch in strike.
 - .4 No preload excreted on electrified hardware.
 - .5 Door does not rub on floor or any part of frame.
 - .6 Door Closure is adjusted properly, (Not Over tightened to make up for other door deficiencies).
 - .7 No excessive gaps under, above or between twin doors.

3.3 ADJUSTING

- .1 Adjust door hardware for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to provide tight fit at contact points with frames.

3.4 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Clean hardware with damp cloth and approved non-abrasive cleaner. Polish hardware in accordance with manufacturer's instructions.
- .3 Remove protective material from hardware items where present.
- .4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.5 DEMONSTRATION

- .1 Maintenance Staff Briefing:
 - .1 Brief maintenance staff regarding:
 - .1 Proper care, cleaning and general maintenance of projects complete hardware.
 - .2 Description, use, handling, and storage of keys.
 - .3 Use, application and storage of wrenches for locksets and door closers.
 - .2 Demonstrate operation, operating components, adjustment features and lubrication requirements.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 07 92 00 - Joint Sealants

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI):
 - .1 ANSI Z97.1-2015, Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test
- .2 ASTM International (ASTM):
 - .1 ASTM C542-05, Standard Specification for Lock-Strip Gaskets
 - .2 ASTM C1503-18, Standard Specification for Silvered Flat Glass Mirror
 - .3 ASTM D790-17, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - .4 ASTM D1003-13, Standard Test Method for Haze and Luminous Transmittance of Plastics
 - .5 ASTM D1929-20, Standard Test Method for Determining Ignition Temperature of Plastics
 - .6 ASTM D2240-15e1, Standard Test Method for Rubber Property - Durometer Hardness
 - .7 ASTM E84-20, Standard Test Method for Surface Burning Characteristics of Building Materials
 - .8 ASTM E330-02, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
 - .9 ASTM F1233-08, Standard Test Method for Security Glazing Materials and Systems
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-12.1-2017, Safety Glazing
 - .2 CAN/CGSB-12.2-M 91, Flat, Clear Sheet Glass
 - .3 CAN/CGSB-12.3-M 91, Flat, Clear Float Glass
 - .4 CAN/CGSB-12.4-M 91, Heat Absorbing Glass
 - .5 CAN/CGSB-12.6-M 91, Transparent (One-Way) Mirrors
 - .6 CAN/CGSB-12.8-2017, Insulating Glass Units
 - .7 CAN/CGSB-12.9-M 91, Spandrel Glass
 - .8 CAN/CGSB-12.10-M 76, Glass, Light and Heat Reflecting
 - .9 CAN/CGSB-12.12-M 90, Plastic Safety Glazing Sheets
 - .10 CAN/CGSB-12.13-M 91, Patterned Glass
- .4 National Glass Association with GANA (NGA):
 - .1 GANA Glazing Manual-2008
 - .2 Laminated Glazing Reference Manual-2019
- .5 ULC Standards (ULC):
 - .1 CAN/ULC S102-10, Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .2 CAN/ULC S104-10, Standard Method of Fire Tests for Door Assemblies
 - .3 CAN/ULC S106-15, Standard Method of Fire Tests of Windows and Glass Block Assemblies
- .6 United States Consumer Product Safety Commission (CPSC):
 - .1 CPSC 16 CFR 1201 – Safety Standard for Architectural Glazing Materials

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings: Convene meeting 1 week before beginning work of this Section and on-site installation, with Contractor, Subcontractor Consultant in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other Subcontractors.
 - .4 Review manufacturer's written installation instructions and warranty requirements.
- .2 Sequencing: Comply with manufacturer's recommendations for sequencing construction operations.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, product literature and data sheets for glass, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit WHMIS SDS.
- .3 Shop Drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Samples:
 - .1 Submit for review and acceptance of each type of unit.
 - .2 Samples will not be returned for inclusion into Work.
- .5 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .6 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
 - .1 Submit testing and analysis of glass under provisions of Section 01 43 00 - Quality Assurance.
 - .2 Submit shop testing for glass.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Submit maintenance data for glazing and incorporate into manual.

1.6 QUALITY ASSURANCE

- .1 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .2 Mock-ups: Construct mock-ups in accordance with Section 01 43 00 - Quality Assurance.
 - .1 Construct mock-up to include glass glazing.
 - .2 Mock-up will be used:
 - .1 To judge quality of work, substrate preparation, and material application.
 - .3 Consultant will require minimum 24 hours to review the mock-up.
 - .4 Approved mock-up may remain as part of finished Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors in a clean dry location and in accordance with manufacturer's recommendations.
 - .2 Store and protect glazing from nicks, scratches, and edge damage.
 - .3 Protect prefinished aluminum surfaces with wrapping strippable coating.
 - .4 Replace defective or damaged materials with new.

1.8 AMBIENT CONDITIONS

- .1 Ambient Requirements:
 - .1 Install glazing when ambient temperature is 10 °C minimum. Maintain ventilated environment for 24 hours after application.
 - .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.
 - .3 Refer to manufacturer's instructions for minimum ambient temperature for application of bird deterrent glazing film.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Design Criteria:
 - .1 Ensure continuity of building enclosure vapour and air barrier using glass and glazing materials as follow:
 - .2 Utilize inner lite of multiple lite sealed units for continuity of air and vapour seal.
 - .3 Size glass to withstand wind loads, dead loads and positive and negative live loads [acting normal to plane of glass to design pressure of to ASTM E330.
 - .4 Limit glass deflection to 1/200 with full recovery of glazing materials.
 - .5 Exterior glazing design and materials: to CSA Standard A460 for bird-friendly design.
- .2 Flat Glass:
 - .1 Float glass: to CAN/CGSB-12.3, glazing quality, 6 mm thick.
 - .2 Sheet glass: to CAN/CGSB-12.2, AA-special selected, 6mm thick.
 - .3 Safety glass: to CAN/CGSB-12.1, transparent, 6 mm thick.
 - .1 Type 2-Tempered
 - .2 Class B-float.
 - .3 Category 1.
 - .4 Fire rated ceramic glass: to CAN/ULC S104 and CAN/ULC S106, ceramic glass, laminated:
 - .1 Thickness: 8 mm.
 - .2 Finish: Standard polished on both faces.
 - .3 Fire rating: as scheduled.
 - .4 [Impact safety rating: to ANSI Z97.1 and CPSC 16 CFR 1201 Cat. I and II.
 - .5 Low emissivity (LOW E) glass, 6mm thick.
 - .1 Metallic coating: soft, sputtered.
 - .2 Light transmittance: 60%.
 - .3 Solar heat gain coefficient (SHGC): 0.25.
 - .4 U-Value: winter 0.335 maximum, summer 0.203 maximum.

- .3 Insulating Glass Units:
 - .1 Insulating glass units: to CAN/CGSB-12.8, double unit, 25 mm overall thickness.
 - .1 Glass: to CAN/CGSB-12.3.
 - .2 Glass thickness: 6mm each lite.
 - .3 Inter-cavity space thickness: 12mm with low conductivity spacers.
 - .4 Glass coating: surface number 2, low "E".
 - .5 Inert gas fill: argon.
- .4 Sealant: in accordance with Section 07 92 00 - Joint Sealants.
 - .1 VOC limit 250 g/L maximum to SCAQMD Rule 1168.

2.2 ACCESSORIES

- .1 Setting blocks: neoprene, 80-90 Shore A durometer hardness to ASTM D2240, length of 25 mm for each square metre of glazing.
- .2 Spacer shims: neoprene, 50-60 Shore A durometer hardness to ASTM D2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self-adhesive on one face.
- .3 Glazing tape:
 - .1 Preformed butyl compound with integral resilient tube spacing device, 10-15 Shore A durometer hardness to ASTM D2240; coiled on release paper; black colour.
- .4 Glazing clips: manufacturer's standard type.
- .5 Lock-strip gaskets: to ASTM C542.

2.3 GLASS SCHEDULE:

- .1 GL-1: Tempered Glass (Typ. Interior Doors, Interior Sidelights & Admin. Window)
 - .1 Thickness: 6mm
 - .2 Decorative Glazing where shown.
- .2 GL-2: Laminated Insulating Glass Units (Typical Exterior Doors & Windows):
 - .1 Insulating glass units: to CAN/CGSB-12.8, double unit, 25 mm overall thickness.
 - .1 6mm Tempered Glass.
 - .2 Inter-cavity space thickness: 12mm with low conductivity spacers.
 - .1 Glass coating: surface number 2 - low "E"
 - .2 Inert gas fill: argon.
 - .3 6mm Tempered Glass
- .3 GL-3 - Fire Rated Interior Single Glazing:
 - .1 Laminated Ceramic Glass:
 - .1 Thickness: 8mm overall.
 - .2 Approximate Visible Transmission: 85 percent.
 - .3 Approximate Visible Reflection: 9 percent.
 - .4 Fire-rating: 20 minutes to 3 hours for doors.
 - .5 Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
 - .6 STC Rating: Approximately 38 dB.
 - .7 Surface Finish:
 - .1 Standard Grade is polished for a surface quality that is comparable to alternative fire-rated ceramics marketed as having a premium finish.
 - .2 Labeling: Permanently label each piece of Glazing with the Manufacturer logo, ULC logo and fire rating.

- .8 Fire Rating: Fire rating classified and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ASTM E2010-01, ULC Standards CAN4 S-104 and CAN4 S-106, NPFA 252 and NFPA 257.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: Verify conditions of substrates previously installed are acceptable for beginning glazing installation in accordance with manufacturer's instructions.
 - .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 Visually inspect substrates.
 - .4 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .5 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Consultant.

3.2 PREPARATION

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.
- .4 Preparation - Glazing films:
 - .1 Clean glazing before beginning installation using neutral cleaning solution.
 - .2 Ensure no deleterious material adheres to glazing.
 - .3 Ensure dust, grease, and chemical residue are removed from surface of glazing before installation of film.
 - .4 Examine glazing under natural daylight and identify cracks, blisters, bubbles, discolouration, edge defects or other anomalies that may cause film to delaminate or cause vision transparency or distortion problems.

3.3 INSTALLATION: EXTERIOR - DRY METHOD (PREFORMED GLAZING)

- .1 Manufacturer's Instructions: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.
- .3 Cut glazing tape to length; install on glazing lite. Seal corners by butting tape and sealing junctions with sealant.
- .4 Place setting blocks at 1/3 points, with edge block maximum 150 mm from corners.
- .5 Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- .6 Install removable stops without displacing glazing tape. Exert pressure for full continuous contact.
- .7 Trim protruding tape edge.

3.4 INSTALLATION: INTERIOR - DRY METHOD (TAPE AND TAPE)

- .1 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.
- .2 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.
- .3 Place setting blocks at 1/3 points, with edge block maximum 150 mm from corners.
- .4 Rest glazing on setting blocks and push against tape for full contact at perimeter of lite or unit.
- .5 Place glazing tape on free perimeter of glazing in same manner described.
- .6 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- .7 Knife trim protruding tape.

3.5 INSTALLATION: PLASTIC FILM

- .1 Install plastic film in accordance with film manufacturer's instructions.
- .2 Place without air bubbles, creases, or visible distortion.
- .3 Site Installation of Glazing Film:
 - .1 Remove window stops and window sealing device.
 - .2 Ensure dust, grease, and chemical residue are removed from surface of glazing before installation of film.
 - .3 Examine glazing under natural daylight and identify cracks, blisters, bubbles, discolouration, edge defects or other anomalies that may cause film to delaminate, or cause vision transparency or distortion problems. Report findings to Consultant before starting work.
 - .4 Proceed with work only after receipt of written approval from Consultant.
 - .5 Install glazing film to glazing windows ensuring no blisters, bubbles, scratches, or distortions.
- .4 Cut film edges straight and square.
- .5 Ensure film is installed behind window stops. Cut edges in accordance with manufacturer's written instructions.
- .6 Splicing:
 - .1 Splice film only when glazing is greater in width than film.
 - .2 Splice film only after receipt of written approval from Departmental Representative.
 - .3 Use butted factory edges only.
 - .4 Ensure maximum overlap of 3 mm.
- .7 Use only water and film slip solution on glazing to facilitate positioning of film.
- .8 Ensure removal of excess water from between film and glazing.
- .9 Re-install stops and sealing devices.
- .10 Wash interior and exterior of each window and film, using cleaning solution recommended by film manufacturer.

- .11 Remove and replace film that continues to show blisters, bubbles, tears, scratches, edge defects or vision distortion in film when viewed under natural daylight from 2.0 metres minimum after 30 day period.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove traces of primer and sealants.
 - .2 Remove glazing materials from finish surfaces.
 - .3 Remove labels.
 - .4 Clean glass [and mirrors] using approved non-abrasive cleaner in accordance with manufacturer's instructions.
- .2 Waste Management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal.

3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 After installation, mark each lite with an "X" by using removable plastic tape or paste.
 - .1 Do not mark heat absorbing or reflective glass units.
- .3 Repair damage to adjacent materials caused by glazing installation.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 08 80 00 - Glazing.

1.2 REFERENCE STANDARDS

- .1 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS).
- .2 International Window Film Association (IWFA)
 - .1 IWFA Visual Quality Standard for Applied Window Film - 1999.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures
- .2 Product Data:
 - .1 Submit product data for each specified product.
 - .2 Include installation instructions for glazing film.
 - .3 Include manufacturer's material safety data sheets for the safe handling of the specified materials and products, in accordance with Workplace Hazardous Materials Information Service (WHMIS) requirements.
- .3 Shop Drawings: Submit dimensioned elevations showing the layout of glazing film on the glass panels.
- .4 Samples: Submit duplicate 500 mm x 500 mm samples of each type of film installed on 5 mm thick clear plate glass.
- .5 Maintenance Data:
 - .1 Provide maintenance data for glazing film for incorporation into the operation and maintenance manual specified in Section 01 78 00 – Closeout Procedures.
 - .2 Include the manufacturer's written instructions for the care and maintenance of the glazing film and a list of cleaning solutions recommended by the manufacturer for regularly scheduled cleaning of glazing film.
- .6 Sustainable Design Submittals:
 - .1 Construction Waste Management: Coordinate with Section 01 74 19 – Waste Management and Disposal.
 - .2 Low-Emitting Materials: Submit a listing of adhesives, paints, and coatings used in the building. Comply with Section 01 35 21 – Sustainable Requirements.
 - .3 Sustainable Requirements: Coordinate with Section 01 35 21 – Sustainable Requirements.

1.4 PRECAUTIONS

- .1 Health and Safety:
 - .1 Do the work in accordance with the construction occupational health and safety provisions of Section 01 35 29.06 Health and Safety Requirements.

- .2 Comply with requirements of WHMIS regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to Canada Labour Code.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and the manufacturer's instructions.
- .2 Provide and maintain dry, off ground weatherproof storage.
- .3 Store rolls of film flat on cross supports. Do not stand rolls of film on end.
- .4 Remove from storage, in quantities required for same day use.
- .5 Store materials in accordance with manufacturers written instructions.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Handle and dispose of waste materials generated by the work of this Section, including packaging materials, in accordance with Section 01 74 19 –Waste Management and Disposal.
 - .1 Separate and recycle waste materials in accordance with the WRW Plan.
 - .2 Place materials defined as hazardous or toxic waste in designated containers.
 - .3 Ensure emptied containers are sealed and stored safely.

1.7 WARRANTY

- .1 For the work of this Section 08 87 16 Glazing Films, the 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to 24 months.
- .2 Warrant that the glazing film will stay in place without delaminating, peeling or blistering and will maintain appearance without discolouration.
- .3 In the event of product failure under the warranty terms, remove and re apply the glazing film without glass replacement at no cost to the Owner.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Code GF1 – Translucent Glazing Film:
 - .1 Surface Finish: Matte
 - .2 Material: Polyester
 - .3 Adhesive type: Pressure-sensitive
 - .4 Thickness: 1.969 mil
 - .5 Shading Coefficient (%): 0.44
 - .6 Visible light reflectance (%): 43
 - .7 Visible light transmittance (%): 21
 - .8 Basis of design 3M Fasara Milky Milky SH2MAMM

2.2 FACTORY INSTALLATION

- .1 Shop installation of security film to glass panels:
 - .1 Ensure dust, grease, and chemical residue are removed from surface of glass before installation of film.
 - .2 Examine glass under natural daylight and identify cracks, blisters, bubbles, discolouration, edge defects or other anomalies that may cause film to delaminate, or cause vision transparency or distortion problems.
 - .3 View glass from 2 m maximum. Report findings to the Consultant.
 - .4 Proceed with the work only after receipt of written approval from the Consultant.
 - .1 Install glazing film to glass panels ensuring no blisters, bubbles, scratches, edge defects or distortions.
 - .2 Cut film edges straight and square to within 3 mm of edge of panel.
 - .3 Ensure that the film dries flat without dimples, blisters or distortions within 30 calendar days.
 - .4 Deliver glass panels complete with security film installed and labels intact and legible to the site.

PART 3 EXECUTION

3.1 PREPARATION FOR FIELD INSTALLATION

- .1 Clean glass before beginning installation using neutral cleaning solution.
- .2 Ensure no deleterious material adheres to glass by scraping surface of glass using industrial razors.
- .3 Ensure dust, grease, and chemical residue are removed from surface of glass before installation of film.
- .4 Examine glass under natural daylight and identify cracks, blisters, bubbles, discolouration, edge defects or other anomalies that may cause film to delaminate or cause vision transparency or distortion problems. Report findings to the Consultant.
- .5 Proceed with Work only after receipt of written approval from the Consultant.
- .6 Before beginning Work, place absorbent material on sill of glazing panel to absorb moisture accumulation generated by film application.

3.2 FIELD INSTALLATION

- .1 Field Installation of glazing film to glass:
 - .1 Remove any window stops and window sealing device.
 - .2 Ensure no deleterious material adheres to glass by scraping surface of glass using industrial razors.
 - .3 Ensure dust, grease, and chemical residue are removed from surface of glass before installation of film.
 - .4 Examine glass under natural daylight and identify cracks, blisters, bubbles, discolouration, edge defects or other anomalies that may cause film to delaminate, or cause vision transparency or distortion problems. Report findings to the Consultant before starting Work.
 - .5 Proceed with the work only after receipt of written approval from the Consultant.
 - .6 Install glazing film to glass ensuring no blisters, bubbles, scratches or distortions.
- .2 Cut film edges straight and square.

- .3 Cut edges in accordance with the manufacturer's written instructions.
- .4 Apply and attach film to glass in accordance with manufacturer's written instructions.
- .5 Splicing:
 - .1 Splice film only when glass is greater in width than film.
 - .2 Splice film only after receipt of written approval from the Consultant.
 - .3 Use butt factory edges only.
- .6 Use only water and film slip solution on the glass to facilitate positioning of the film.
- .7 Ensure removal of excess water from between the film and the glass.
- .8 Remove leftover material from the work area and return the work area to its original condition.

3.3 INSTALLER'S INSPECTION

- .1 Visual Inspection: in accordance with IWFA Visual Quality Standard for Applied Window Film.
- .2 Remove and replace without glass replacement, film that continues to show blisters, bubbles, tears, scratches, edge defects or vision distortion in film when viewed under natural daylight from 2 m minimum after a 30 day period.

3.4 FINAL CLEANING

- .1 Wash both faces of each glass panel and film using a cleaning solution recommended by the film manufacturer.
- .2 Remove from the premises all surplus material, dirt and debris caused by the work of this Section and leave the installation clean.
- .3 Make good any damage to other work caused by the work of this Section.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 The Aluminum Association Inc. (AA):
 - .1 AA DAF-45-2003, Designation System for Aluminum Finishes
- .2 Air Movement and Control Association International (AMCA):
 - .1 AMCA 500-D-18, Laboratory Methods of Testing Dampers for Rating
 - .2 AMCA 500-L-12, Laboratory Methods of Testing Louvers for Rating
 - .3 AMCA 501-17, Application Manual for Air Louvers
 - .4 AMCA 511-21, Certified Ratings Program for Air Control Devices
- .3 American National Standards Institute (ANSI):
 - .1 ANSI H35.1/H35.1M-17, Alloy and Temper Designation Systems for Aluminum
- .4 ASTM International (ASTM):
 - .1 ASTM A240/A240M-20A, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - .2 ASTM A653/A653 M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .3 ASTM A1008/A1008M-13, 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
 - .4 ASTM B32-20, Standard Specification for Solder Metal
 - .5 ASTM B209/B209M-21a, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - .6 ASTM B221M-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
 - .7 ASTM B370-12, Standard Specification for Copper Sheet and Strip for Building Construction
 - .8 ASTM D523-14, Standard Test Method for Specular Gloss
 - .9 ASTM D822/D822M-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposure of Paint and Related Coatings
 - .10 ASTM E2886/E2886M-20, Standard Test Method for Evaluating the Ability of Exterior Vents to Resist the Entry of Embers and Direct Flame Impingement
- .5 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.213-2004, Etch Primer (Pretreatment Coating of Tie Coat) for Steel and Aluminum
 - .2 CAN/CGSB-93.1-M85, Sheet Aluminum Alloy, Prefinished, Residential
- .6 Public Services and Procurement Canada (PSPC)/ Public Works and Government Services Canada (PWGSC):
 - .1 MD 15000-2012, Mechanical Environmental Standard for Federal Office Buildings

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finishes, and limitations.
 - .2 Submit WHMIS SDS - Safety Data Sheets.

- .3 Shop Drawings: Indicate fabrication and erection details, including anchorage, accessories, and finishes.
- .4 Samples:
 - .1 Submit duplicate samples of each type of louvre showing colour and finish.
 - .2 Show frame detail, screening and finish.
 - .3 Where colour is not indicated, submit manufacturer's standard colours on actual metal substrate for Consultant's selection.
- .5 Manufacturer Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.
- .6 Closeout Submittals: Submit operation and maintenance data for manually operated or motorized louvres and incorporate into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Protect louvres from nicks, scratches, and blemishes.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Weather resistant louvres, with bird screens made to withstand a wind load of not less than 1.44 kilopascals.
- .2 Wall louvers: complete with AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-L and AMCA 511.
- .3 Ratings to indicate water penetration of 0.06 kilograms or less per square metre of free area at free velocity of 244 meters per minute.
- .4 Galvanized steel sheet: commercial quality to ASTM A653/A653M with Z275 zinc coating.
- .5 Steel sheet: commercial quality to ASTM A1008/A1008M with Class I matte finish.
- .6 Aluminum sheet: to ASTM B209/B209M, alloy 3003 with temper as required for forming, mill finish plain utility sheet.
- .7 Aluminum extrusions: to ASTM B221M alloy 6063-T5.
- .8 Solder: to ASTM B32, 50% tin and 50% lead.
- .9 Flux: suitable for materials to be soldered.
- .10 Nails and fasteners: same material as fabricated items.
- .11 Gaskets: vinyl.
- .12 Primer: to CAN/CGSB-1.213.

- .13 Prefinished steel sheet:
 - .1 Prefinished steel with factory applied polyvinylidene fluoride.
 - .1 Class F1S.
 - .2 Colour: selected by Consultant from manufacturer's standard range].
 - .3 Specular gloss: 30 units +/- in accordance with ASTM D523.
 - .4 Coating thickness: not less than 22 micrometres.
 - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822/D822M as follows:
 - .1 Outdoor exposure period 2500 hours.
 - .2 Humidity resistance exposure period 5000 hours.
 - .2 Prefinished steel with factory applied polyvinyl chloride.
 - .1 Class F1S
 - .2 Colour selected by Consultant from manufacturer's standard range.
 - .3 Specular gloss: 30 units +/-5 in accordance with ASTM D523.
 - .4 Coating thickness: not less than 200 micrometres.
 - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822/D822M as follows.
 - .1 Outdoor exposure period 5000 hours.
 - .2 Humidity resistance exposure period 5000 hours.
 - .14 Prefinished aluminum sheet:
 - .1 Finish aluminum sheet metal with factory applied coating to CAN 2-93.1 amended as follows:
 - .1 Type 1.
 - .2 Class F1S.
 - .3 Colour selected by Consultant from manufacturer's standard range.
 - .4 Coating thickness: not less than 200 micrometres.
 - .5 Exposure period for humidity resistance 5000 hours.
 - .6 Exposure period for salt spray resistance 5000 hours.
 - .15 Screens:
 - .1 Insect screens: minimum 0.3 mm diameter aluminum wire 18 x 14 mesh, minimum 60% free area, secured to aluminum frame.
 - .2 Birdscreens: crimped aluminum wire cloth secured to minimum 2.0 mm thick extruded aluminum frame mitered at corners and secured with corner locks.
 - .16 Formed sheet metal louvres:
 - .1 Fabricate sheet metal louvres from stock.
 - .2 Form blades, mullions and frames to sizes and shapes indicated.
 - .3 Provide concealed vertical stiffeners spaced to meet required loads.
 - .4 Complete louver assembly to have 50% free area.
 - .5 Apply one coat of shop primer.
 - .6 Attach bird & insect screen to inside face of louver.
 - .17 Extruded aluminum louvres:
 - .1 Construct louvres from aluminum extrusions of minimum 3 mm thickness to sizes and shapes indicated.
 - .2 Arrange blades, mullions and frame extrusions as indicated.
 - .3 Install concealed vertical stiffeners spaced to meet required loads.
 - .4 Complete louver assembly to have minimum 50% free area.
-

2.2 FINISHES

- .1 Finish exposed surfaces of aluminum components in accordance with [ANSI H35.1/H35.1M for Aluminum Finishes.
 - .1 Electrolytically deposited colour anodic finish. Colour to match Consultant's sample.
- .2 Appearance and properties of anodized finishes designated by the Aluminum Association as Architectural Class 1, Architectural Class 2, and Protective and Decorative.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install louvres where indicated.
- .2 Set adjustable louver blades for uniform alignment in open and closed positions.
- .3 Adjust louvres so moving parts operate smoothly.
- .4 Attach bird and insect screen to inside face of louver or vent.
- .5 Repair damage to louvres to match original finish.
- .6 Install wall louvers using stops, mouldings, flanges, strap anchors or jamb fasteners as appropriate for wall construction and in accordance with manufacturer's recommendations.
- .7 Install louvers in wood doors by using metal "Z" mouldings.
 - .1 Fasten mouldings to door with screws.

3.2 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.

3.3 PROTECTION

- .1 Paint copper or copper-bearing alloys in contact with dissimilar metal with heavy-bodied bituminous paint or separate with inert membrane.
- .2 Where aluminum contacts metal other than zinc, paint dissimilar metal with primer and two coats of aluminum paint.
- .3 Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.
- .4 Paint wood or other absorptive materials that may become repeatedly wet and in contact with metal with two coats of aluminum paint or coat of heavy-bodied bituminous paint.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Gypsum board for interior partition and ceiling assemblies.
 - .2 Gypsum board sheathing for exterior walls.

1.2 RELATED REQUIREMENTS

- .1 Section 06 10 53 - Miscellaneous Rough Carpentry
- .2 Section 07 21 16 - Blanket Insulation
- .3 Section 07 26 00 - Vapour Retarders
- .4 Section 07 92 00 - Joint Sealants
- .5 Section 08 31 00 - Access Doors and Panels
- .6 Section 09 22 16 - Non-Structural Metal Framing
- .7 Section 09 91 23 - Interior Painting

1.3 REFERENCE STANDARDS

- .1 Aluminum Association (AA):
 - .1 AA DAF 45-03, Designation System for Aluminum Finishes
- .2 ASTM International (ASTM):
 - .1 ASTM C473-19, Standard Test Methods for Physical Testing of Gypsum Panel Products
 - .2 ASTM C475/C475M-17, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
 - .3 ASTM C514-04, Standard Specification for Nails for the Application of Gypsum Board
 - .4 ASTM C557-03, Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing
 - .5 ASTM C840-18b, Standard Specification for Application and Finishing of Gypsum Board
 - .6 ASTM C954-18, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
 - .7 ASTM C1002-07, 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
 - .8 ASTM C1047-19, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
 - .9 ASTM C1177/C1177M-17, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
 - .10 ASTM C1178/C1178M-18, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board
 - .11 ASTM C1278/C1278M-24, Standard Specification for Fiber-Reinforced Gypsum Panel
 - .12 ASTM C1280-13, Standard Specification for Application of Gypsum Sheathing
 - .13 ASTM C1396/C1396M-17, Standard Specification for Gypsum Board
 - .14 ASTM C1629/C1629M-23, Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels

- .15 ASTM C1658/C1658M-18, Standard Specification for Glass Mat Gypsum Panels
- .16 ASTM C1766-15, Standard Specification for Factory-Laminated Gypsum Panel Products
- .17 ASTM C1881-20, Standard Guide for Closed-Loop Recycling of Scrap Gypsum Panel Products
- .18 ASTM D3273-21, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- .19 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- .20 ASTM E413-16, Classification for Rating Sound Insulation
- .21 ASTM F1233-21, Standard Test Method for Security Glazing Materials And Systems
- .3 California Air Resources Board (CARB):
 - .1 2007 Suggested Control Measure (SCM) for Architectural Coatings
- .4 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction
- .5 Gypsum Association (GA):
 - .1 GA-214-2021, Levels of Finish for Gypsum Panel Products
 - .2 GA-801-2023, Handling and Storage of Gypsum Panel Products: A Guide for Distributors, Retailers, and Contractors
- .6 South Coast Air Quality Management District (SCAQMD):
 - .1 SCAQMD Rule 1113-2016, Architectural Coatings
 - .2 SCAQMD Rule 1168-2022, Adhesives and Sealants Applications
- .7 Underwriters' Laboratories Inc. (UL):
 - .1 UL 2762-2011, Standard for Sustainability for Adhesives
- .8 ULC Standards (ULC):
 - .1 CAN/ULC-S101-14, Standard Method of Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC-S102-10, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with Section 07 21 16 - Blanket Insulation for acoustic batt insulation in interior partitions and thermal batt insulation in exterior assemblies.
 - .2 Coordinate with Section 08 31 00 - Access Doors and Panels for installation in gypsum board assemblies.
 - .3 Coordinate with 09 91 23 - Interior Painting] for paint gloss levels that require a Level 5 gypsum board finish.
- .2 Pre-Installation Meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by the Consultant and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review installation and substrate conditions.
 - .1 Review environmental and ambient conditions for locations where it is acceptable for paper-faced gypsum board to be substituted with glass mat gypsum board to facilitate construction details and sequencing.
 - .4 Coordinate with other Subcontractors.
 - .5 Review manufacturer's instructions.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Product literature and data sheets, including product characteristics, performance criteria, physical sizes, and limitations.
 - .1 Submit product data for:
 - .1 gypsum board and panel materials
 - .2 joint tapes
 - .3 joint compounds
 - .4 casing beads
 - .5 corner beads
 - .6 control joints
 - .7 edge trims
 - .8 cornice caps
 - .9 mouldings
 - .2 Submit ULC fire-resistance assembly listings for each fire-rated assembly indicated in the Contract Documents.
 - .3 Submit product data for assemblies indicating STC value based on testing of materials proposed for use on the Project.
- .3 Shop Drawings:
 - .1 Indicate components, including fastener types, dimensions, spacing, locations at gypsum board edges, ends, and infield of board, and installation methods.
 - .2 Show locations and sizes of blocking and nailers. Include concealed blocking and reinforcement specified in other sections.
 - .3 Indicate type of joint compound, and number of joint compound layers.
 - .4 Indicate quantities and locations of electrical boxes for walls [and ceilings].
- .4 Samples:
 - .1 Samples for initial selection: Full range of samples, representing available colours, patterns, textures, and finishes.
 - .1 Submit samples for:
 - .1 each gypsum board
 - .2 each exposed control joint
 - .3 each exposed edge trim
 - .4 each exposed cornice cap
 - .5 each exposed shadow mould
 - .6 each exposed moulding
 - .2 Samples for verification: Manufacturer's standard samples to verify specified colours, patterns, and textures, and finishes.
 - .1 Submit samples for:
 - .1 300 mm x 300 mm of each gypsum board
 - .2 300 mm length of each exposed control joint
 - .3 300 mm length of each exposed edge trim
 - .4 300 mm length of each exposed cornice cap
 - .5 300 mm length of each exposed shadow mould
 - .6 300 mm length of each exposed moulding
 - .2 Samples will be returned.
 - .5 Manufacturer's instructions:
 - .1 Special delivery, storage, and handling requirements.
 - .2 Installation instructions.
 - .3 Recommended sequencing.
 - .4 Cleaning procedures.

1.6 QUALITY ASSURANCE

- .1 Mock-Ups: Erect in accordance with Section 01 43 00 - Quality Assurance.
 - .1 Install one [of each type] of gypsum board wall assembly, including one interior corner, one exterior corner, one vertical joint, and one horizontal joint.
 - .1 Minimum size: 3m x 3m.
 - .2 Location: Acceptable to Consultant.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements, and:
 - .1 Comply with GA-801 when handling or storing gypsum panel products.
 - .2 Carefully unload gypsum board shipment to prevent damage to edges and corners.
 - .3 Store and protect gypsum board materials from scratches, condensation, excessive humidity, and water damage.
 - .4 Handle gypsum boards to prevent damage to edges, ends, and surfaces.
 - .5 Protect ready-mix joint compounds from freezing, exposure to extreme heat, and direct sunlight.
 - .6 Protect prefinished aluminum surfaces with wrapping or strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.8 SITE CONDITIONS

- .1 Ambient Conditions: Maintain environmental conditions in accordance with ASTM C840 and:
 - .1 Ventilate application areas, immediately after apply joint treatments, to remove excess moisture that might prevent proper drying of joints.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- .1 Fire-resistance-rated assemblies: Provide materials identical to those in indicated assemblies tested in accordance with CAN/ULC-S101 by an independent testing agency.
- .2 Acoustic assemblies: Provide materials identical to those in indicated assemblies tested in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD AND PANEL MATERIALS

- .1 Sustainability characteristics:
 - .1 Recycled content: Minimum 75% post-consumer and pre-consumer.
 - .2 Provide GREENGUARD Gold Certified gypsum board products.
- .2 Gypsum Wallboard: To ASTM C1396/C1396M, regular and Type X.
 - .1 Board size: 1220 mm wide x maximum practical lengths to suit application lengths.
 - .2 Board thickness: As indicated on Drawings.
 - .3 Long edges: Tapered.

- .3 Gypsum ceiling board: To ASTM C1396/C1396M, regular.
 - .1 Board size: 1220 mm wide x maximum practical lengths to suit application lengths.
 - .2 Board thickness: 12.7 mm.
 - .3 Long edges: Tapered.
 - .4 Surface burning characteristics: To CAN/ULC-S102.
 - .1 Flame-spread rating: 0 maximum.
 - .2 Smoke developed classification: 0 maximum.
- .4 Glass mat water-resistant gypsum backing board: To ASTM C1178/C1178M, regular, mould resistant.
 - .1 Board size: 1220 mm wide x maximum practical lengths to suit application lengths.
 - .2 Board thickness: As indicated on Drawings.
 - .3 Edges and ends: Square.
 - .4 Surface burning characteristics: To CAN/ULC-S102.
 - .1 Flame-spread rating: 0 maximum.
 - .2 Smoke developed classification: 0 maximum.
- .5 Gypsum sheathing board: To ASTM C1396/C1396M, non-combustible water-resistant core, water-resistant paper surfaces, 1220 mm width x maximum practical lengths, thicknesses indicated on Drawings.
 - .1 Board size: 1220mm wide x maximum practical lengths to suit application lengths.
 - .2 Board thickness: As indicated on Drawings.
 - .3 Edges and ends: Square.
 - .4 Surface burning characteristics: To CAN/ULC-S102.
 - .1 Flame-spread rating: 0 maximum.
 - .2 Smoke developed classification: 0 maximum.

2.3 ACCESSORIES

- .1 Miscellaneous framing: In accordance with Section 09 22 16 - Non-Structural Metal Framing.
 - .1 Furring channels
 - .2 Furring brackets
 - .3 Tie wires
 - .4 Inserts
 - .5 Flat straps and backing plates
 - .6 Anchors
- .2 Nails: To ASTM C514.
- .3 Steel screws:
 - .1 Fastening gypsum board and gypsum sheathing to steel members less than 0.84 mm: To ASTM C1002, type S fine thread screws.
 - .2 Fastening gypsum board and gypsum sheathing to steel members from 0.84 mm to 2.84 mm thick: To ASTM C954.
 - .3 Fastening gypsum board to gypsum board (two-layer applications): To ASTM C1002, type G course-pitch high-thread self-piercing screws.
- .4 Joint tape: To [ASTM C475/C475M], as recommended by manufacturer for application type. Use mould-resistant tape for moisture-resistant boards.
- .5 Joint compound: To [ASTM C475/C475M], as recommended by the manufacturer for application type.

- .6 Casing beads, corner beads, control joints, and edge trim: To ASTM C1047, zinc-coated steel, minimum 0.5 mm base thickness, perforated flanges, one piece length per location.
 - .1 Colour: As selected by the Consultant from manufacturer's standard colour range].
- .7 Sealants: Type in accordance with Section 07 92 00 - Joint Sealants.
- .8 Acoustic sealant: In accordance with Section 07 92 00 - Joint Sealants. Refer to Section 07 84 00 - Firestopping for additional requirements.
- .9 Insulating gaskets: Moisture-resistant, nominal 3mm thick, closed cell neoprene or polyethylene strip, width to match framing, with self-sticking permanent adhesive on one face, lengths as required.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Verify substrates are dry, clean, and frost free.
 - .2 Verify wood framing is installed in accordance with Section 06 10 53 - Miscellaneous Rough Carpentry.
 - .3 Verify metal framing is installed in accordance with Section 05 41 00 - Structural Metal Stud Framing and Section 09 22 16 - Non-Structural Metal Framing.
 - .4 Verify substrates are installed in accordance with ASTM C840.
 - .5 Verify substrate tolerances are suitable to achieve specified finished assembly tolerances.
 - .6 Verify bucks, anchors, blocking, and sound attenuation materials are installed.
 - .7 Verify work to be concealed has been reviewed and inspected by authority having jurisdiction (AHJ) (if required) and corrective work is completed, if any.

3.2 GENERAL INSTALLATION REQUIREMENTS

- .1 Fire-resistance-rated assemblies: Provide construction identical to that in indicated assemblies tested in accordance with CAN/ULC-S101 by an independent testing agency.
- .2 Acoustic assemblies: Provide construction identical to that in indicated assemblies tested in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency for assembly STC ratings indicated on Drawings.

3.3 GYPSUM BOARD ASSEMBLY INSTALLATION

- .1 Erect metal framing in accordance with Section 09 22 16 - Non-Structural Metal Framing.
- .2 Install blocking, backing, and reinforcements in accordance with Section 06 10 53 - Miscellaneous Rough Carpentry.
- .3 Acoustic sealants:
 - .1 Apply two beads under track and one bead under each layer of gypsum board.
 - .2 Apply one bead of acoustic sealant continuously around periphery of each face of partitions to seal gypsum board/structure junction where partitions abut fixed building components.
 - .3 Apply sealant around penetrating mechanical and electrical work to maintain sound rating.
 - .4 Locate sealant so that it is covered after finishes are applied.
 - .5 Construct fire-rated assemblies using fire stopping sealant applied after acoustic sealant.

- .4 Install acoustical batt insulation and thermal batt insulation in exterior assemblies in accordance with Section 07 21 16 - Blanket Insulation.
- .5 Install gypsum board in accordance with ASTM C840.
- .6 Install gypsum sheathing to ASTM C1280.
- .7 Secure gypsum board to framing without damaging gypsum board edges or ends.
- .8 Apply single or double-layer gypsum board to metal furring or framing using screw fasteners for first layer, screw fasteners for second layer. Maximum screw spacing 300 mm on-centre.
 - .1 Single-layer application:
 - .1 Apply gypsum board on ceilings before application of walls.
 - .2 Apply gypsum board on walls vertically or horizontally, providing sheet lengths to minimize number of board edges or end joints.
 - .2 Double-layer application:
 - .1 Install gypsum board for base layer and exposed gypsum board for face layer.
 - .2 Apply base layer to ceilings before base layer application on walls; apply face layers in same sequence. Offset joints between layers minimum 250 mm.
 - .3 Apply base layers at right angles to supports unless otherwise indicated.
 - .4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset minimum 250 mm with base layer joints.
- .9 Install ceiling boards in direction to minimize number of end-butt joints. Stagger end joints at least 250 mm.
- .10 Apply water-resistant gypsum board where wall tiles and adjacent to slop sinks. Apply water-resistant sealant to edges, ends, and cut-outs which expose gypsum core, and to fastener heads. Do not apply joint treatment on areas to receive tile finish.
- .11 Install gypsum board with face side outwards.
- .12 Do not install damaged or damp boards, or boards with evidence of mould growth.

3.4 ACCESSORY INSTALLATION

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on-centre.
- .2 Install casing beads around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces without trim concealing junction and where indicated. Seal joints with sealant.
- .4 Install insulating gasket strips continuously at edges of gypsum board [, at casing beads abutting exterior [metal] window and door frames,] and where indicated on Drawings, to provide a thermal break.
- .5 Control and expansion joints:
 - .1 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.
 - .2 Provide continuous polyethylene dust barrier behind and across control joints.
 - .3 Locate control joints at maximum 9 m spacing on partitions and ceilings and at maximum 15 m spacing on ceilings without perimeter relief.

- .4 Locate control joints to coincide with the corner of a door, window, or screen frame where possible.
- .5 Construct expansion joints [as detailed,] at building expansion and construction joints. Provide continuous dust barrier.
- .6 Construct control and expansion joints to maintain sound-rated construction and fire ratings.
- .6 Install cornice caps where gypsum board partitions do not extend to ceiling. Fit cornice caps over partition, secure to partition top track with two rows of sheet metal screws staggered at 300 mm on-centre.
- .7 Splice corners and intersections together and secure to each member with three screws.
- .8 Install access doors [o electrical and mechanical fixtures specified in respective sections and in accordance with Section 08 31 00 - Access Doors and Panels.
 - .1 Rigidly secure frames to furring or framing systems.

3.5 FINISHING

- .1 Finish face panel joints and interior angles with joint system consisting of joint compound, joint tape, and taping compound installed in accordance with manufacturer's instructions and feathered out onto panel faces.
- .2 Gypsum Board Finish: Finish gypsum board walls and ceilings to the following levels in accordance with ASTM C840 or GA-214.
 - .1 Levels of finish:
 - .1 Level 4: Embed tape for joints and interior angles in [joint] compound and immediately wiped clean with a joint knife or trowel leaving a thin coating of [joint] compound over the joints and interior angles. Apply two separate coats of [joint] compound over flat joints. Apply one separate coat of [joint] compound over interior angles. Cover fastener heads and accessories with three separate coats of [joint] compound. Surfaces to be smooth and free of tool marks and ridges.
 - .1 Locations: As indicated on Drawings.
 - .1 gypsum board to receive wall coverings.
 - .2 gypsum board to receive a light texture finish.
- .3 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent uncoated surface of gypsum board.
- .4 Skim coating:
 - .1 Mix joint compound slightly thinner than for joint taping.
 - .2 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations, or tool marks.
 - .3 Allow skim coat to dry completely.
 - .4 Remove ridges by light sanding or wiping with damp cloth.
- .5 Textured finish:
 - .1 Mask adjacent surfaces where required to protect from overspray.
 - .2 Apply one coat of primer-sealer over surface to be textured.
 - .3 When dry, apply textured finish in accordance with manufacturer's instructions to produce a uniform texture, free of thin areas and application patterns.
 - .4 Immediately remove droppings and accidental overspray.

3.6 TOLERANCES

- .1 Maximum variation of finished gypsum board surface from true flatness: 3 mm in 3000 mm in any direction.

3.7 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning, and:
 - .1 Completely remove joint compounds from concrete floors.
- .2 Waste management:
 - .1 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal and:
 - .1 Separate scrap gypsum board materials for waste diversion, recycling in accordance with ASTM C1881.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 07 92 00 - Joint Sealants

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM C645-14e1, Standard Specification for Nonstructural Steel Framing Members.
 - .2 ASTM A653/A653M-07, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.
 - .3 ASTM C754-15, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- .2 Underwriter's Laboratories (UL)
 - .1 UL-2768-2011, Architectural Surface Coatings.
- .3 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual-current edition.
 - .1 MPI #26, Primer, Galvanized Metal, Cementitious.
- .4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for [metal framing] and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 29 - Health, Safety, and Emergency Response Procedures.
- .3 Samples:
 - .1 Submit duplicate 300 mm long samples of non-structural metal framing.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .3 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of [post-consumer] [and] [post-industrial] content, and total cost of materials for Project.

1.4 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal framing from [nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Non-load bearing channel stud framing: to ASTM C645, roll formed from 0.53mm thickness hot dipped zinc-coated (galvanized) steel sheet in accordance with ASTM A653, Z180, for screw attachment of gypsum board.
 - .1 Knock-out service holes at 460 mm centres.
- .2 Floor and ceiling tracks: to ASTM C645, in widths to suit stud sizes, and as follows:
 - .1 Slotted Deflection Track for Fire Separations: Premanufactured slotted top runner with 63 mm down standing legs and having 6 mm wide x 38 mm high slots spaced at 25 mm on centre along length of runner; tested and certified for use in fire rated wall construction.
 - .2 Double Runner Deflection Track: Outside runner using 50 mm flanges; inner runner 33 mm; maintaining 25 mm minimum deflection space.
 - .3 Deep Leg Deflection Track: Top runner having 75 mm down standing legs; maintaining 13 mm minimum deflection space.
 - .4 Base Runner: Bottom track with 33 mm upstanding legs.
- .3 Furring Channels: Commercial steel sheet in accordance with ASTM A653, Z180, hot dipped zinc-coated (galvanized), as follows:
 - .1 Hat Shaped, Rigid Furring Channels: ASTM C645, 0.75 mm thickness x 22 mm deep
 - .2 Resilient Furring Channels: 0.46 mm thickness x 13 mm deep members designed to reduce sound transmission having asymmetrical face attached to single flange by a slotted leg (web).
- .4 Metal channel stiffener: 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.

- .5 Acoustical sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .6 Sealants: VOC limit 30g/L maximum to SCAQMD Rule 1168.
- .7 Insulating strip: rubberized, moisture resistant 3 mm thick foam strip, 12 mm wide, with self sticking adhesive on one face, lengths as required.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for non-structural metal framing application in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Consultant.

3.2 ERECTION

- .1 Erect partitions in accordance with framing requirements of ASTM C754
- .2 Align partition tracks at floor and ceiling and secure at 610 mm on centre maximum.
- .3 Install damp proof course under stud shoe tracks of partitions on slabs on grade.
- .4 Place studs vertically at 406 mm on centre and not more than 50 mm from abutting walls, and at each side of openings and corners.
 - .1 Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .5 Erect metal studding to tolerance of 1:1000.
- .6 Attach studs to bottom and ceiling track using screws.
- .7 Co-ordinate simultaneous erection of studs with installation of service lines. Align web openings when erecting studs.
- .8 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
- .9 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified.
 - .1 Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .10 Install heavy gauge single jamb studs at openings.
- .11 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs.
 - .1 Secure track to studs at each end, in accordance with manufacturer's instructions.
 - .2 Install intermediate studs above and below openings in same manner and spacing as wall studs.

- .12 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .13 Provide 40 mm stud or furring channel secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.
- .14 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .15 Extend partitions to ceiling height except where noted otherwise on drawings.
- .16 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.
 - .1 Use double track slip joint.
- .17 Install continuous insulating strips to isolate studs from uninsulated surfaces.
- .18 Install two continuous beads of acoustical sealant under studs and tracks around perimeter of sound control partitions.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .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 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .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 non-structural metal framing application.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete
- .2 Section 06 10 53 - Miscellaneous Rough Carpentry
- .3 Section 07 92 00 - Joint Sealants
- .4 Section 08 71 00 - Door Hardware
- .5 Section 09 21 16 - Gypsum Board Assemblies

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI):
 - .1 ANSI A108/A118/A136.1:2024, American National Specifications for the Installation of Ceramic Tile
 - .2 ANSI A137.1:2022, American National Standard Specifications for Ceramic Tile
 - .3 ANSI A137.2:2022, American National Specifications for Glass Tile
 - .4 ANSI A138.1:2011, Green Squared American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials
 - .5 ANSI A326.3-2021, American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials
- .2 ASTM International (ASTM):
 - .1 ASTM C97/C97M-18, Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone
 - .2 ASTM C144-24, Standard Specification for Aggregate for Masonry Mortar
 - .3 ASTM C207-24, Standard Specification for Hydrated Lime for Masonry Purposes
 - .4 ASTM C373-18, Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products
 - .5 ASTM C627-18, Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester
 - .6 ASTM C847-18, Standard Specification for Metal Lath
 - .7 ASTM C1027-19, Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile
 - .8 ASTM C1325-22e1, Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units
 - .9 ASTM F2170-19a, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors
 - .2 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction
 - .3 CGSB 71-GP-22M-78, Adhesive, Organic, for Installation of Ceramic Wall Tile
 - .4 CAN/CGSB-75.1-M88, Tile, Ceramic
- .4 CSA Group (CSA):
 - .1 CSA A123.3-05, Asphalt saturated organic roofing felt
 - .2 CSA A3000-18, Cementitious materials compendium

- .3 CSA B651-18, Accessible design for the built environment
- .4 CSA/ASC B651:23, Accessible design for the built environment
- .5 CSA O121-17, Douglas fir plywood
- .5 Environment and Climate Change Canada (ECCC):
 - .1 [Volatile Organic Compound\(VOC\) Concentration Limits for Architectural Coatings Regulations,\(SOR/2009-264\)](#)
 - .2 [Volatile Organic Compound ConcentrationLimits for Certain Products Regulations \(SOR/2021-268\)](#)
- .6 Green Seal (GS):
 - .1 GS-11-21, Paints, Coatings, Stains, and Sealers
 - .2 GS-36-13, Adhesives for Commercial Use
- .7 South Coast Air Quality Management District (SCAQMD):
 - .1 SCAQMD Rule 1113-2016, Architectural Coatings
 - .2 SCAQMD Rule 1168-2022, Adhesive and Sealant Applications
- .8 Terrazzo, Tile and Marble Association of Canada (TTMAC):
 - .1 TTMAC Hard Surface Maintenance Guide (2017-2019)
 - .2 TTMAC Tile Installer Technical Handbook, (2023-2024)
- .9 Tile Council of North America (TCNA):
 - .1 TCNA Handbook for Ceramic, Glass, and Stone Tile Installation, 2024
- .10 Underwriters' Laboratories Inc. (UL):
 - .1 UL 2761-2011, Standard for Sustainability for Sealants and Caulking Compounds
 - .2 UL 2762-2011, Standard for Sustainability for Adhesives

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with Section 03 30 00 - Cast-in-Place Concrete for recessed floor slabs where required to provide floor tile finishes flush with adjacent floor finishes. Coordinate floor slab depression depths, before concrete placement, to accommodate mortar bed, bond coat, and tile thicknesses.
- .2 Pre-installation meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by the Consultant, tile installers, mortar and grout manufacturer representative, waterproofing/crack isolation membrane manufacturer representative, and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review installation and substrate conditions:
 - .1 Substrate and backing surfaces flatness requirements.
 - .2 Compatibility between specified and adjacent materials.
 - .3 Substrate joints and cracks that could affect tile joint locations.
 - .4 Review manufacturer's instructions and warranty requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: Product literature and data sheets, including product characteristics, performance criteria, physical sizes, finishes, and limitations.
 - .1 Submit product data for:
 - .1 each type of tile, including trims
 - .2 primers
 - .3 mortars
 - .4 adhesives
 - .5 grout
 - .6 cleavage membranes
 - .7 waterproofing membranes
 - .8 crack isolation membranes
 - .9 uncoupling membranes
 - .10 sound isolation membranes
 - .11 cementitious backer units
 - .12 foam backer units
 - .13 straight edge and transition strips
 - .14 reducer strips
 - .15 prefabricated movement joints
 - .16 sealants
 - .17 floor sealers
 - .18 thresholds
 - .2 Submit WHMIS SDSs for:
 - .1 primers
 - .2 adhesives
 - .3 sealants
- .3 Shop drawings:
 - .1 Show locations of tile finish, dimensioned plans and elevations, and attachment details.
 - .2 Show conditions affecting installation.
 - .3 Show special tile patterns.
 - .4 Show locations of transitions between differing materials and locations and configuration of inserts and edging details.
 - .5 Show widths, details, and locations of control and movement joints in tile substrates and finished tile surfaces.
 - .6 Show swim lane lines and other pool markings and special patterns.
- .4 Samples:
 - .1 Samples for initial selection: Representing manufacturer's full range of available colours, patterns, textures, and finishes.
 - .1 Submit samples for:
 - .1 each type of tile
 - .2 grout sections
 - .3 straight edge strips
 - .4 transition strips
 - .5 reducer strips
 - .2 Samples for verification: Manufacturer's standard samples to verify specified colours, patterns, and textures, and finishes.
 - .1 Submit samples for:
 - .1 each type of tile
 - .2 grout sections

- .3 straight edge strips
 - .4 transition strips
 - .5 reducer strips
- .2 Submit sample panel, including three horizontal and three vertical tiles, adhered to 19 mm-thick plywood, to show grout colours and joint widths.
- .5 Certificates: Where products from more than one manufacturer are used in one tile assembly, submit a statement from setting material manufacturer to certify compatibility of other manufacturers' materials.
- .6 Manufacturer's instructions:
 - .1 Special delivery, storage, and handling requirements.
 - .2 Installation instructions.
 - .3 Recommended sequencing.
 - .4 Cleaning procedures.
- .7 Site quality control submittals: Indicate results of tests and inspections specified in SITE QUALITY CONTROL in this section.
- .8 Manufacturer's reports:
 - .1 Confirming work of this section complies with manufacturer's requirements as specified in SITE QUALITY CONTROL in this section.
 - .2 Submit within 5 Working Days of promptly after site visit.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance data:
 - .1 Include, in the operation and maintenance manual, manufacturer's maintenance instructions and recommended cleaning materials and methods.
 - .1 Indicate specific warnings for maintenance materials or practices that might damage tile work.
 - .2 Submit TTMAC Hard Surface Maintenance Guide, in digital format.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Extra stock materials:
 - .1 Supply minimum 2% of each type and colour of installed tile.
 - .2 Supply extra stock materials from the same production run as installed materials.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturers:
 - .1 Employing trained technical service representatives and available to provide manufacturer services as specified in SITE QUALITY CONTROL in this section.
 - .2 Installers:
 - .1 Member in good standing with TTMAC.

- .2 Mock-ups: Erect in accordance with Section 01 43 00 - Quality Assurance.
 - .1 Assemble one typical washroom indicating floor and wall tile patterns, grout, and reducer strips.
 - .2 Location: On site, as directed by] the Consultant.
 - .3 Acceptable mock-up may remain as part of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements, and:
 - .1 Examine materials upon delivery. Open boxes and confirm materials match reviewed samples, are free from defects or damage detrimental to final appearance and installation. Tile materials factory marked as seconds or that are not consistent with materials submitted for review are not acceptable.
 - .2 Verify tiles with colour/pattern variations were blended at the factory, so tile units taken from one package show the same range of colours/patterns as those taken from other packages. If tiles are packaged without factory blending, blend tiles on site before installation.
 - .3 Store cementitious materials indoors, in dry location, protected from foreign materials.
 - .4 Protect adhesives, fillers, and sealants from freezing.

1.9 SITE CONDITIONS

- .1 Ambient conditions:
 - .1 Maintain air temperature and substrate temperatures at tile installation area above 12°C for 48 hours before, during, and 48 hours after installation.
 - .2 Install tiles at temperatures between 12°C and 38°C.
 - .3 Install epoxy mortar and grouts at temperatures between 15°C and 25°C.
 - .4 Provide additional heat when there is a risk surface temperatures may drop below manufacturer's recommended temperatures.

PART 2 PRODUCTS

2.1 COMMON PRODUCT REQUIREMENTS

- .1 Provide floor tile products manufactured and tested in accordance with ANSI A108/A118/A136.1 or ISO 10545 Series.
- .2 Sustainability characteristics:
 - .1 Provide products certified as meeting the mandatory requirements of ANSI A138.1.

2.2 FLOOR TILE

- .1 Performance/design criteria:
 - .1 Slip resistance:
 - .1 Dynamic coefficient of friction (DCOF): To ANSI A137.1, minimum 0.42 wet when tested using BOT 3000 Digital Tribometer.
 - .2 Shod ramp slip resistance: To DIN EN 16165, R-class R10 (>10° to 19 or better.
 - .2 Floor traffic loadbearing performance for horizontal ceramic tile assemblies: To ASTM C627, heavy duty (passing cycles 1 through 12.
 - .3 Tile frost resistance: Maximum water absorption rating of 0.5% to ISO 10545-3 or ASTM C373 for ceramic tile.
 - .4 Water absorption class: [Less than 0.5] [0.5 to 3.0] [3.0 to 6.0] [6.0 to 10.0] [Greater than 10]%, in accordance with [ASTM C97/C97M] [ASTM C373] [ISO 13006] [CAN/CGSB-75.1-M88 MR[1] [2] [3] [4]].
 - .5 Abrasion and tread wear resistance: To ISO 10545-7, Class [0] [1] [2] [3] [4] [5]] [ASTM

- C1027, passing minimum [100] [150] [600] [750] [1500] [2100] [6000] [12 000]-revolution stage without visual failure].
- .6 Breaking strength (modulus of rupture): To ISO 10545-4, greater than [3.5] N/mm².
- .7 Chemical resistance: [Not required] [Pass rating [for specified application]] [To ISO 10545-13, Class [A] [B] [C] [LA] [LB] [LC] [HA] [HB] [HC]].
- .8 Stain resistance: To [ISO 10545-14], Class [5 (stain removed with hot water)] [4 (stain removed with weak cleaner)] [3 (stain removed with strong cleaner)] [2 (stain removed with specific solvents)] [1 (stain not removed)].
- .2 Sustainability characteristics:
- .1 Recycled content: Minimum [50]% [post-consumer] [and] [pre-consumer].
- .3 [Type [FT1]:] Ceramic tile To [ISO 10545] [ANSI A108/A118/A136.1] [CAN/CGSB-75.1-88], [porcelain] [impervious natural clay] [vitreous natural clay] [non-porous glass] [with abrasive admixture].
- .1 Size: [[Nominal] [300] [400][] mm × [300] [400][] mm × [9.5] mm thick] [As scheduled] [As indicated on [Drawings]].
- .2 Appearance: [Plain] [Granular] [Mottled] [Solid] [Polished] [As scheduled] [As indicated on [Drawings]].
- .3 Pattern: [Textured] [Non-textured] [slate] [stone] [random] [As scheduled] [As indicated on [Drawings]].
- .4 Glaze: [Unglazed] [Bright] [Clear] [Crystalline] [Fritted] [Matte] [Opaque] [Semi-matte] [Speckled] [As scheduled] [As indicated on [Drawings]].
- .5 Aesthetic class: To ANSI A137.1: [V0] [V1] [V2] [V3] [V4].
- .6 Colour: [] [As scheduled] [As indicated on [Drawings]] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].
- .4 [Type [FT 2]:] Ceramic Mosaic Tile: To [ISO 13006] [ANSI A137.1] [CAN/CGSB-75.1-M88], [porcelain] [impervious natural clay] [vitreous natural clay] [non-porous glass] [with abrasive admixture].
- .1 Pre-spaced tile adhered to [[paper] [or] [open weave fabric]] with a water-soluble adhesive.
- .2 Size: [[Nominal] [25] mm × [25] mm × [] mm thick] [As scheduled] [As indicated on [Drawings]].
- .3 Appearance: [Plain] [Granular] [Mottled] [Solid] [Polished] [As scheduled] [As indicated on [Drawings]].
- .4 Pattern: [Textured] [Non-textured] [slate] [stone] [random] [As scheduled] [As indicated on [Drawings]].
- .5 Glaze: [Unglazed] [Bright] [Clear] [Crystalline] [Fritted] [Matte] [Opaque] [Semi-matte] [Speckled] [As scheduled] [As indicated on [Drawings]].
- .6 Colour: [] [As scheduled] [As indicated on [Drawings]] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].

2.3 WALL TILE

- .1 Performance/design criteria:
- .1 Water absorption class: [Less than 0.5] [0.5 to 3.0] [3.0 to 6.0] [6.0 to 10.0] [Greater than 10]%, in accordance with [ASTM C97/C97M] [ASTM C373] [ISO 13006] [CAN/CGSB-75.1-M88 MR[1] [2] [3] [4]].
- .2 Chemical resistance: [Not required] [Pass rating [for specified application]] [In accordance with ISO 10545-13, Class [[A] [B] [C] [LA] [LB] [LC] [HA] [HB] [HC]].
- .3 Stain resistance: To [ISO 10545-14], Class [5 (stain removed with hot water)] [4 (stain removed with weak cleaner)] [3 (stain removed with strong cleaner)] [2 (stain removed with specific solvents)] [1 (stain not removed)].

- .2 Sustainability characteristics:
 - .1 Recycled content: Minimum [50]% [post-consumer] [and] [pre-consumer].
- .3 [Type [WT 1]:] [Ceramic] [Glass] Tile: To [ISO 10545] [ANSI A108/A118/A136.1] [ANSI A137.2] [CAN/CGSB-75.1-M], [Porcelain] [Impervious natural clay] [Vitreous natural clay] [Non-porous glass].
 - .1 Size: [[Nominal] [75] [150] [300][] mm × [152] [300] [600][] mm × [] mm thick] [As scheduled] [As indicated on [Drawings]].
 - .2 Appearance: [Plain] [Granular] [Mottled] [Solid] [Polished] [As scheduled] [As indicated on [Drawings]].
 - .3 Pattern: [Textured] [Non-textured] [slate] [stone] [random] [As scheduled] [As indicated on [Drawings]].
 - .4 Glaze: [Unglazed] [Bright] [Clear] [Crystalline] [Fritted] [Matte] [Opaque] [Semi-matte] [Speckled] [As scheduled] [As indicated on [Drawings]].
 - .5 Colour: [] [White] [As scheduled] [As indicated on [Drawings]] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].

2.4 BASE TILE

- .1 Sustainability characteristics:
 - .1 Recycled content: Minimum [50]% [post-consumer] [and] [pre-consumer].
- .2 [Type [TB1 1]:] Base size, colour, and texture to match adjacent flooring material.
 - .1 Profile: [Coved] [Straight], [with factory finished top edge] [top edge ready for applied trim].
 - .2 Height: [[100] [150] [200][] mm] [As scheduled] [As indicated on [Drawings]].

2.5 TILE TRIMS

- .1 Sustainability characteristics:
 - .1 Recycled content: Minimum [50]% [post-consumer] [and] [pre-consumer].
- .2 Tile trim shape sizes: [Same size as adjacent [wall] tile] [As scheduled] [As indicated on [Drawings]].
- .3 Stair tile trims:
 - .1 [Bullnose] edge, slip-resistant surface, pattern matching floor tile, sized to suit stair treads.
 - .2 Colour: [Colour contrasting to stair tread] [As scheduled] [As indicated on [Drawings]] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].
- .4 Tile trim at [shower floor tiles] [shower overflow ledges] [and] [shower curbs]:
 - .1 Slip resistance:
 - .1 Dynamic coefficient of friction (DCOF): To [ANSI A137.1] [ANSI A326.3], minimum [0.42] [dry] [wet] when tested using BOT 3000 Digital Tribometer.
 - .2 Shod ramp slip resistance: To DIN EN 16165, R-class [R9 (6° to 10°)] [R10 (>10° to 19°)] [R11 (>19° to 27°)] [R12 (>27° to 35°)] [R13 (>35°)] or better.
- .5 Tile trims at internal and external wall corners:
 - .1 External corners: Bullnose shapes.
 - .2 Internal corners: Coved shapes.
- .6 Tile trims at countertops: [Cove] [and] [bullnose] shapes.
- .7 Tile trim special shapes:
 - .1 Base-to-floor internal corners to provide integral coved vertical and horizontal joint.
 - .2 Base-to-floor external corners to provide bullnose vertical edge with integral coved horizontal

- joint. Use as stop at bottom of openings having bullnose return to wall.
- .3 At partial height walls:
 - .1 Wall top edge internal corners to provide integral coved vertical joint with [bullnose] top edge.
 - .2 Wall top edge external corners to provide [bullnose] vertical and horizontal joint edge.
- .8 Ceramic soap holders: [Semi-recessed] [Recessed] [Surface mounted], [150] mm × [150] mm face dimension, colour to match surrounding wall tile.

2.6 MORTAR, ADHESIVE, AND GROUT MATERIALS

- .1 Primers: Low viscosity primer as recommended by manufacturer to suit substrates and site conditions. Submit proof of bonding ability of setting system if manufacturer says primer is not required.
 - .1 Sustainability characteristics:
 - .1 VOC and other chemical limits for on-site, wet-applied products: To [Section 01 35 21 - LEED Requirements] [Section 01 47 15 - Sustainable Requirements: Construction] [CARB SCM for Architectural Coatings] [GS-11] [SCAQMD Rule 1113] [ECCC SOR/2009-264].
- .2 Surface preparation materials:
 - .1 Portland cement mortar: [Scratch [and bond] coat] [Levelling bed] containing the following:
 - .1 Portland cement: To [CSA A3000], Type GU.
 - .2 Hydrated lime: To [ASTM C207], Type [[N] [NA] [S] [SA]].
 - .3 Sand: To [ASTM C144], passing 1.18 mm sieve.
 - .4 Water: Potable, free of minerals and chemicals which are detrimental to mortar and grout mixes.
 - .2 Self-levelling and smoothing underlayment: To [ANSI A108.01, Type 2], cementitious self-leveling smoothing underlayment. [Capable of a feather edge.] [Products containing gypsum are not acceptable.]
 - .1 Compressive strength: [24] [25] [27] [29] MPa at 28 days.
 - .2 Tensile strength: [2.4] [3] MPa at 28 days.
 - .3 Flexural strength: [6] [7] MPa at 28 days.
- .3 Wall tile systems:
 - .1 Thin set interior installations: To [ANSI A118.1], dry set mortar, formulated for thin set applications, factory sanded mortar consisting of Portland cement, sand, and additives requiring only addition of potable water for installation [with bond enhancing latex additive].
 - .2 Thin set exterior installation: To [ANSI A118.1], frost resistant, dry set mortar, formulated for thin set applications with bond enhancing latex additive.
 - .3 Exterior grade plywood (EGP) latex-Portland cement mortar: To [ANSI A118.11], factory blended, bond enhanced latex modified Portland cement.
- .4 Floor tile systems:
 - .1 [Thin] [Medium] set interior installations: To [ANSI A118.1] [ANSI A118.4], latex-Portland cement mortar, rated for specified floor traffic loadbearing performance.
- .5 Adhesive systems:
 - .1 Epoxy adhesive: To [ANSI A108.01] [ANSI A118.3] [ISO 13007-1, Type R2], thin set adhesive system using 100% solids epoxy resin and epoxy hardener. Stain-proof, chemical-resistant, high temperature resistance, thermal shock resistant, [non-flammable] and water-cleanable.
 - .1 Compressive strength: [] MPa.
 - .2 Bond strength: [] MPa.
 - .3 Water absorption: Maximum []%.
 - .4 Ozone resistance (200 hours at 200 ppm): [No loss of strength].
 - .5 Sustainability characteristics:

- .1 VOC and other chemical limits: To [Section 01 35 21 - LEED Requirements] [Section 01 47 15 - Sustainable Requirements: Construction] [GS-36] [SCAQMD Rule 1168] [UL 2762] [ECCC SOR/2021-268].
- .2 Organic adhesive: To [ANSI A136.1] [CGSB 71-GP-22M, Type [1] [2]], thin set wall tile adhesive system; non-flammable, water-resistant, latex adhesives, recommended for interior applications.
 - .1 Sustainability characteristics:
 - .1 VOC and other chemical limits: To [Section 01 35 21 - LEED Requirements] [Section 01 47 15 - Sustainable Requirements: Construction] [GS-36] [SCAQMD Rule 1168] [UL 2762] [ECCC SOR/2021-268].
- .6 Grout: With non-fading pigments.
 - .1 Unsanded Portland cement grout: To [ANSI A118.6], factory blended latex-Portland cement grout, specifically formulated for joints maximum 3 mm wide.
 - .2 Sanded Portland cement grout: To [ANSI A118.6], factory blended dry-set stain-resistant [latex modified] [commercial] Portland cement and graded silica sand, specifically formulated for joints greater than 3 mm wide.
 - .3 Polymer modified grout: To [ANSI A118.7], factory blended stain resistant polymer modified Portland cement, specifically formulated for joints greater than 3 mm wide.
 - .4 Epoxy grout: To [ANSI A118.3], water-cleanable, chemical-resistant, factory blended modified Portland cement compound, 100% epoxy additives and hardeners.
 - .5 Furan grout: To [ANSI A118.5], [_____].
 - .6 Grout colours: [_____] [White] [Black] [Light grey] [Light sand] [As scheduled] [As indicated on [Drawings]] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].
 - .1 Site-mixed colouring pigments for grout are not acceptable.

2.7 MIXES

- .1 Mix premanufactured mortars and grouts in accordance with [ANSI A108/A118/A136.1], and mortar and grout manufacturers' instructions. Perform site mixing to add water only.
- .2 Site mix proportioned mortar and grout materials as follows:
 - .1 Scratch coat (by volume): Mix one part Portland cement, four parts sand, and latex additive where required by [TTMAC] [TCNA] details.
 - .2 Slurry bond coat: Mix Portland cement and water to creamy paste consistency. Include latex additive where required by [TTMAC] [TCNA] details.
 - .3 Mortar bed for walls (by volume): Mix one part Portland cement, four parts sand, and [latex] [and] [hydrated lime] additives where required by [TTMAC] [TCNA] details.
 - .4 Levelling coat (by volume): Mix one part Portland cement, four parts sand, and latex additive where required by [TTMAC] [TCNA] details.
 - .5 Mortar bed for floors: Mix one part Portland cement, four parts sand, and latex additive where required by [TTMAC] [TCNA] details; when mixed with water the mortar bed consistency and workability should allow maximum compaction during tamping of the mortar bed, and achieve a minimum compressive strength of 15 MPa after 28 days. A stronger mix can be achieved by adding latex to the water.
- .3 Where allowed in material manufacturer's instructions, adjust water volume depending on moisture content of sand to obtain consistency and workability.

2.8 ACCESSORIES

- .1 Wood underlayment: [In accordance with [Section 06 10 53 - Miscellaneous Rough Carpentry] [Section 06 08 99 - Rough Carpentry for Minor Works]] [To CSA O121, Exterior Douglas fir (EXT-

DFP) plywood, Sheathing grade, no knot fillers or adhesives detrimental to tiling products, minimum 16 mm thickness, square edged.]

- .2 Cleavage membranes: [To CAN/CGSB-51.34-M, polyethylene film, [150 µm] thick] [or] [To CSA A123.3, Type 1, perforated asphalt saturated roofing felt].
- .3 Waterproofing [and crack isolation] membranes: To ANSI A108.01, ANSI A118.10, [and ANSI A118.12], loadbearing, [premanufactured self-adhering] [or] [liquid-applied, lightweight fabric reinforced] membrane. Thickness recommended by manufacturer to accommodate in-plane substrate movement of [2] [3] mm in thin set application.
- .4 Crack isolation membranes: To ANSI A108.01 and ANSI A118.12, loadbearing, [premanufactured self-adhering] [or] [liquid-applied, lightweight fabric reinforced] membrane. Thickness recommended by manufacturer to accommodate in-plane substrate movement of [2] [3] mm in thin set application.
- .5 Uncoupling membranes: To A108.01, loadbearing, [premanufactured self-adhering] [or] [liquid-applied, lightweight fabric reinforced] membrane. Thickness recommended by manufacturer to accommodate in-plane substrate movement of [2] [3] mm in thin set application.
- .6 Sound reduction membranes: To ANSI A108.01 and ANSI A118.13, loadbearing, [premanufactured self-adhering] [or] [liquid-applied, lightweight fabric reinforced] sound attenuation membrane; thickness as recommended by manufacturer to accommodate in-plane substrate movement in thin set applications.
- .7 Cementitious backer units: [To [ASTM C1325] [or] [ANSI A108/A118/A136.1]], [reinforced Portland cement board, reinforcing mesh embedded near both faces] [In accordance with Section 09 21 16 - Gypsum Board Assemblies].
- .8 Foam backer units: [To ANSI A118.10,] closed-cell [polyisocyanurate] [or] [polystyrene] foam panels, with reinforced and textured [polypropylene] [or] [fibreglass] facers, waterproof.
 - .1 Provide manufacturer's recommended accessory products for foam backer units as required, including fasteners, seaming tape, sealant, and [] for a complete watertight installation.
 - .2 Provide manufacturer's preformed [shower pan] [and] [curbs] for a complete system.
- .9 Reinforcing mesh: Welded wire fabric flat sheets, [50] mm × [50] mm openings, [1.6] mm-diameter galvanized steel wire.
- .10 Metal lath: To [ASTM C847], expanded steel lath, galvanized, [[1.0] [1.4] [1.6] [1.8] [1.9] [2.1]] kg/m³.
- .11 Latex additive: Formulated for use in Portland cement mortars and grouts.
- .12 Water: Potable, clean, and free of chemicals and contaminants detrimental to mortar and grout mixes.
- .13 Straight edge and transition strips: Purpose made with integral perforated anchoring leg for setting transition strip into setting material, with manufacturer's alignment connector and end pieces[, and designed for smooth curved applications].
 - .1 Material: [Roll formed stainless steel] [Brass] [Mill finished extruded aluminum] [Clear anodized extruded aluminum] [Colour anodized extruded aluminum] [As scheduled] [As indicated on [Drawings]] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].
 - .2 Profile: [] [As scheduled] [As indicated on [Drawings]] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].
 - .3 Height: [In accordance with [CSA B651] [CSA/ASC B651]] [As required to suit tile installation].

- .14 Reducer strips: Purpose made.
 - .1 Material: [Roll formed stainless steel] [Brass] [Clear anodized extruded aluminum] [Coloured anodized extruded aluminum] [Mill finished extruded aluminum] [As scheduled] [As indicated on [Drawings]] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].
 - .2 Profile: [In accordance with [CSA B651] [CSA/ASC B651],] [Vertical rise less than 6 mm, vertical or bevelled profile] [Vertical rise of 7 to 13 mm, bevelled profile maximum 1:2 slope] [Vertical rise over 13 mm, bevelled profile maximum 1:12 slope].
 - .3 Height: [As required to suit tile installation.]
- .15 Prefabricated movement joints: Purpose made, [medium duty] [heavy duty], [stainless steel] [brass] [anodized aluminum].
 - .1 Minimum Shore A hardness of [35] [60], elasticity ±[[25] [40][]]]%, when used in accordance with TTMAC Detail 301MJ.
 - .2 Movement zone width: [5] [6] [8] [10] [30] mm.
 - .3 Regulatory requirements:
 - .1 At fire-resistance rated assemblies: Maintain the continuity of fire-resistance ratings.
 - .4 Movement zone component colour: [] [As scheduled] [As indicated on [Drawings]] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].
- .16 Sealants: Type [] in accordance with Section 07 92 00 - Joint Sealants.
 - .1 Sustainability characteristics:
 - .1 VOC and other chemical limits: To [Section 01 35 21 - LEED Requirements] [Section 01 47 15 - Sustainable Requirements: Construction] [GS 11] [SCAQMD Rule 1168] [UL 2761].
 - .2 Colour: [] [Match adjacent grout colour] [Match adjacent tile colour] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].
- .17 Floor sealer: To [CAN/CGSB 25.20, Type [1, solvent-based] [2, water-based]] and as recommended by tile and grout manufacturers.
 - .1 Sustainability characteristics:
 - .1 VOC and other chemical limits for on-site, wet-applied products: To [Section 01 35 21 - LEED Requirements] [Section 01 47 15 - Sustainable Requirements: Construction] [CARB SCM for Architectural Coatings] [GS-11] [SCAQMD Rule 1113] [ECCC SOR/2009-264].
- .18 Thresholds: [[] material, [] mm thick, [rounded edges]] [bevelled [one side] [two sides]], [honed] finish to exposed surfaces, size to suit door opening and frame width [In accordance with Section 08 71 00 - Door Hardware]. Finish [bevel] [round edges] [honed] to match top surface of threshold. Limit height of threshold to maximum 13 mm or less above adjacent floor surface.
 - .1 Finishes: [] [As scheduled] [As indicated on [Drawings]] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].

2.9 SHOWER BASE & DRAIN

- .1 Pre-Fabricated Shower Base:
 - .1 Description: Trapezoid-imprinted, prefabricated, sloped tiled shower tray base, made of lightweight, self-extinguishing (HF-1 rating per UL-94) expanded polystyrene (PS 40), with 12-5/16 inch (313 mm) diameter removable recessed section and bonded membrane 0.008 inch (0.2 mm) thick, which meet or exceed the requirements of the American National Standard Specifications for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation A118.10, and is listed by cUPC, and is evaluated by ICC-ES (see

Report No. ESR-2467). Meeting ANSI A118.10 as detail as referenced in method B422 of the Tile Council of North America Handbook for Ceramic Tile Installation.

.2 Tray with Center Drain Placement:

- .1 38 inch by 60 inch by 1-1/8 inch (97 cm by 152 cm by 29 mm).

.2 Shower Drain:

- .1 Description: floor drain 11-13/16" (300 mm) diameter, trapezoid perforated, sloped integrated bonding flange with thermally laminated polypropylene fleece and grate assembly. Grate assembly includes grate, height adjustment collar, and lateral adjustment ring with trapezoid perforations. Drain listed by ICC-ES (PMG-1204), UPC® (File No. 4591) and CSA (File Number 211355). Drain type as referenced in methods B422, B422C and B422 STONE of the Tile Council of North America Handbook for Ceramic, Glass, and Stone Tile Installation.

.2 Drain Housing Material:

- .1 ABS
.2 PVC

.3 Drain Outlet:

- .1 3" (75 mm) outlet

.4 Nominal Grate Size:

- .1 6" (150 mm) x 6" (150 mm) square

.5 Grate Design, Material and Finish:

.1 Design 1 – Arc-shaped and trapezoid-shaped openings

- .1 E –Stainless Steel Type 304
.2 EP –Stainless Steel Type 304, Polished
.3 EOB –Stainless Steel Type 304, Oil-Rubbed Bronze
.4 ET –Stainless Steel Type 304, Nickel
.5 ECG –Stainless Steel Type 304, Classic Gold
.6 EVG –Stainless Steel Type 304, Vintage Gold
.7 ERG –Stainless Steel Type 304, Rose Gold

.2 Curve – Alternating arc-shaped openings

- .1 EB –Stainless Steel Type 304, Brushed
.2 EBT –Stainless Steel Type 304, Brushed Nickel
.3 EBCG –Stainless Steel Type 304, Brushed Classic Gold
.4 EBVG –Stainless Steel Type 304, Brushed Vintage Gold
.5 EBRG –Stainless Steel Type 304, Brushed Rose Gold
.6 TSC – Color Coated Aluminum, Cream
.7 TSBG – Color Coated Aluminum, Greige
.8 TSSG – Color Coated Aluminum, Stone Grey
.9 TSOB – Color Coated Aluminum, Bronze
.10 MBW – Color Coated Aluminum, Matte White
.11 MGS – Color Coated Aluminum, Matte Black

.3 Floral – Petal-shaped openings

- .1 EB –Stainless Steel Type 304, Brushed
.2 EBT –Stainless Steel Type 304, Brushed Nickel
.3 EBCG –Stainless Steel Type 304, Brushed Classic Gold
.4 EBVG –Stainless Steel Type 304, Brushed Vintage Gold
.5 EBRG –Stainless Steel Type 304, Brushed Rose Gold
.6 TSC – Color Coated Aluminum, Cream
.7 TSBG – Color Coated Aluminum, Greige
.8 TSSG – Color Coated Aluminum, Stone Grey
.9 TSOB – Color Coated Aluminum, Bronze
.10 MBW – Color Coated Aluminum, Matte White
.11 MGS – Color Coated Aluminum, Matte Black

.4 d. Pure – Circular opening with central slot opening

- .1 EB –Stainless Steel Type 304, Brushed
.2 EBT –Stainless Steel Type 304, Brushed Nickel

- .3 EBCG –Stainless Steel Type 304, Brushed Classic Gold
- .4 EBVG –Stainless Steel Type 304, Brushed Vintage Gold
- .5 EBRG –Stainless Steel Type 304, Brushed Rose Gold
- .6 TSC – Color Coated Aluminum, Cream
- .7 TSBG – Color Coated Aluminum, Greige
- .8 TSSG – Color Coated Aluminum, Stone Grey
- .9 TSOB – Color Coated Aluminum, Bronze
- .10 MBW – Color Coated Aluminum, Matte White
- .11 MGS – Color Coated Aluminum, Matte Black
- .5 e. Design 2 - Arc-shaped openings
 - .1 ATGB - Anodized Aluminum, Brushed Nickel
 - .2 AKGB - Anodized Aluminum, Brushed Copper
 - .3 AMGB - Anodized Aluminum, Brushed Brass
 - .4 ECS - Tileable Covering Support, Stainless Steel Type 304

2.10 SHOWER WALLS (WATERPROOF ASSEMBLY)

- .1 Waterproofing and Crack Isolation Membrane: Ready-to-Use Synthetic rubber or Acrylic, specifically designed for bonding to cementitious or gypsum board substrate; and meets or exceeds ANSI A118.10 and ANSI A118.12.
 - .1 Crack Resistance: No failure at 1/4" inch (6.35 mm) gap, minimum.
 - .2 IAPMO approved
 - .3 Waterproofing membrane: Two coats of 25 mils wet film thickness each over the entire surface..
 - .4 Fluid, Spray or Trowel Applied Type
 - .5 Thickness: One coat at 50 mils wet thickness or two coats at 25 mils wet thickness each to obtain maximum 1/4" crack isolation.
 - .6 Accessories:
 - .1 Mesh all vertical and horizontal joints
 - .7 Acceptable Manufacturer:
 - .1 H.B. Fuller, TEC Hydraflex
 - .2 Mapei, AquaDefense
 - .3 CGC, Durock Brand Liquid
 - .4 Laticrete, Hydroban 1

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Verify concrete slabs have cured 28 days, and are sufficiently dry to bond with adhesive, in accordance with manufacturers' recommended bond and moisture test methods.
 - .2 Examine substrates and conditions where tile will be installed for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - .3 Verify substrates for bonding tile are firm, dry, clean, and free from oil, waxy films, and curing compounds.
 - .4 Verify installation of grounds, anchors, recessed frames, electrical and mechanical items, and similar products located in, behind, or through tiling is complete.
 - .5 Verify in substrate joints and cracks align with tile movement joint locations indicated on Drawings. Adjust movement joint locations to align with joints or cracks in consultation

with the Consultant.

- .6 Verify substrate and backing surface flatness tolerances. Section 03 30 00 - Cast-in-Place Concrete establishes a flatness requirement for FF25 for slabs on grade for in-place concrete and is considered the starting flatness for work of this section. Measure final flatness and levelness of mortar beds or self-levelling screeds in accordance with Section 03 30 00 - Cast-in-Place Concrete:
 - .1 Small format floor tile: Tiles less than 100 mm × 100 mm require floor flatness in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - .2 Standard format floor tile: Tiles from 100 mm × 100 mm, with all sides less than 380 mm require minimum FF35, equivalent to 5 mm with maximum two gaps under a 3000 mm straightedge.
 - .3 Large format floor tile: Tiles with any side greater than 380 mm require minimum FF50, equivalent to 3 mm with maximum two gaps under 3000 mm straightedge.
 - .4 Wall tiles: Similar to specified values for floors for tiles having similar sizes listed above.
- .2 Pre-installation testing:
 - .1 Notify the Consultant minimum 72 hours before beginning pre-installation testing.
 - .2 Test concrete substrates in accordance with ASTM F2170.
 - .1 Confirm manufacturer's acceptable relative humidity before testing.
 - .2 Maintain a minimum substrate temperature of 13 °C during testing.
 - .3 Test moisture content of wood substrates before installing flooring using electronic moisture test equipment.

3.2 PREPARATION

- .1 Thoroughly clean substrate surfaces. Remove grease, oil, dust film, concrete surface film-forming products, concrete curing agents, and other contaminants that could reduce adhesion within bonding systems.
 - .1 Clean the back of each tile before installation to remove surface contaminants, cutting residue, firing release dust, and other debris detrimental to bond and final surface appearance.
- .2 Waterproofing membrane: Install membranes in accordance with TTMAC Tile Installer Technical Handbook and membrane manufacturers' instructions.
- .3 Surface levelling: Apply levelling bed mortar or self-levelling mortar to make backing surfaces flat and true to tolerances in plane listed for performance requirements:
 - .1 Install levelling materials at slight substrate irregularities.
 - .2 Provide self-levelling materials for thicknesses less than 8 mm where thin set tile methods are used.
 - .3 Provide mortar bed levelling materials for thicknesses 8 mm and greater.
- .4 Securely screw underlayment to subfloor with good side up. Install sheets with 6 mm gap to allow for expansion and contraction of subfloor materials.
- .5 Install foam backer units, shower pans in accordance with manufacturers' instructions.

3.3 GENERAL INSTALLATION REQUIREMENTS

- .1 Perform tile work in accordance with TTMAC Tile Installer Technical Handbook and ANSI A108/A118/A136.1.
- .2 Lay tile in patterns indicated on Drawings and:

- .1 Align joints when adjoining tiles on floor, base, walls, and trim are the same size.
 - .2 Lay out tile work and centre tile sites in both directions in each space or on each wall area.
 - .3 Centre tile patterns between control and movement joints. Obtain further instructions from the Consultant if tile patterns do not align with control or movement joints.
 - .4 Minimum tile width is one-third unit size.
 - .5 Adjust tile layout to minimize tile cutting.
 - .6 Make joints between tile uniform, plumb, straight, true, and flush with adjacent tile.
 - .7 Provide uniform joint widths between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished work. Align tile sheet patterns.
- .3 Extend tiles into recesses and under equipment and fixtures to create a complete uninterrupted floor covering.
- .1 Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
 - .2 Do not split tile.
 - .3 Cut edges smooth, even, and free from chips.
- .4 Fit tiles around corners, fitments, fixtures, drains, and other built-in objects. Accurately form intersections and returns.
- .1 Fit tiles closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, and covers overlap tile.
- .5 Cut and drill tile accurately and without damage.
- .1 Carefully grind exposed cut tile edges or tile edges abutting trim, finishes, or built-in items for straight aligned joints.
- .6 Sound tiles after setting and replace hollow-sounding units to obtain full bond.
- .7 Slope floor tile towards floor drains in thick-bed mortar installations.
- .8 Tile set in mortar beds: Wait minimum 24 hours after tile installation before grouting.
- .9 Bonding bed installation: Set tile in place while bond coat is wet and tacky.
- .1 Apply a coat of mortar with pressure using the trowel's flat side to key the mortar into the substrate. Apply additional mortar, combing it in a single direction parallel to the tile's shortest dimension, with the trowel's notched side.
 - .2 Provide sufficient bond coat to achieve minimum 80% contact for tiles smaller than 300 mm × 300 mm [and areas with residential or light loadbearing performance requirements] with bonding material evenly dispersed and pressed into back of tile. Back butter larger tiles and installations with moderate or higher loadbearing performance requirements.
 - .3 Place tiles firmly into the wet mortar. Push tiles back and forth, perpendicular to trowel lines, to collapse mortar ridges and help achieve maximum coverage.
 - .4 Verify corners and edges are fully supported by bonding material. Periodically pick up and inspect freshly installed tiles.
 - .5 Set tiles to prevent lippage greater than 1 mm over a 3 mm grout joint.
 - .6 Keep two-thirds of grout joint depth free of bonding materials.
 - .7 Clean excess bonding materials from tile surface before bonding materials' final set.
 - .8 Sound tiles after bonding materials have cured. Replace hollow sounding tiles before grouting.
- .10 Back buttering:
- .1 Achieve 100% mortar coverage of tile in accordance with TTMAC Tile Installer Technical Handbook or TCNA Handbook for Ceramic, Glass, and Stone Tile Installation and ANSI A108/A118/A136.1 for:
 - .1 Glass tiles.

- .2 Tiles at exterior locations.
- .3 Tiles at shower areas.
- .4 Tiles in sauna room.
- .5 Tiles surrounding bathtub.
- .6 Tiles in laundry room.
- .7 Tiles in swimming pool.
- .8 Tiles installed with chemical-resistant mortars and grouts.
- .9 Tiles with any side 300 mm or larger.
- .10 Tiles with raised or textured backs.
- .11 Tile installation areas rated for heavy or extra heavy duty.
- .12 Porcelain tiles with more than 20% of the tile back covered with firing release dust.
- .13 Back buttered tiles with adhesive mortar rated in accordance with ASTM C627, extra heavy duty rating (passing cycles 1 through 14).

- .11 Tolerances:
 - .1 Maximum surface tolerance: 1:800.

3.4 ACCESSORY INSTALLATION

- .1 Install straight edge or transition strips as indicated on Drawings and where floor tiling edge abuts different floor finishes. Provide sloped profile transition strips where uneven transitions occur between 6 mm and 13 mm.
- .2 Install straight edge or profiled transition strips where wall tile abuts different wall finishes.
- .3 Install reducer strips as indicated on Drawings and where tile abuts concrete flooring that will not receive an additional floor finish.

3.5 CONTROL AND MOVEMENT JOINT INSTALLATION

- .1 Install control joints and movement joints in tile work in accordance with TTMAC Detail 301MJ. Keep control and expansion joints free of bonding materials, and as follows:
 - .1 Cut tiles to establish line of joints. Sawed joints after installation of tiles are not acceptable.
 - .2 Locate joints in tile surfaces directly above joints in concrete substrates.
 - .3 Provide floor control joints over structural control joints. Provide wall control joints aligned with vertical structural control joints.
 - .4 Install prefabricated joint profiles in accordance with manufacturer's instructions, set with top surface of joint profile slightly below top surface of tile.
 - .5 Keep control and movement joints free from setting materials.
 - .6 Prepare control joints and apply sealants in accordance with Section 07 92 00 - Joint Sealants.
 - .7 Form open joints in tile for sealant wherever a change in backing material occurs, at all vertical interior corners, around penetrating pipes and fixtures, and where tiles abut other materials and fixtures.
 - .8 Maintain continuity of fire-resistance rated separation.
- .2 Locate control joints as indicated on Drawings and not exceeding spacing in any direction in the following table.

Environment	Minimum Spacing	Maximum Spacing	Minimum Joint Width
Interior/shaded	4800 mm	6100 mm	6 mm

Environment	Minimum Spacing	Maximum Spacing	Minimum Joint Width
Interior/sunlight	2400 mm	3700 mm	6 mm
Exterior/normal	2400 mm	3700 mm	10 mm
Exterior/excessive	2400 mm	3000 mm	13 mm

3.6 GROUT INSTALLATION

- .1 Install grout in accordance with manufacturer's instructions, and the TTMAC Tile Installer Technical Handbook.
 - .1 Allow proper setting time before application of grout.
 - .2 Pre-seal or wax tiles that require protection from grout staining.
 - .3 Force grout into the joints with a rubber grout float. Make sure all joints are well-compacted and free of voids and gaps.
 - .4 Remove excess grout in accordance with manufacturer's instructions and polish tile with clean cloths.

3.7 SITE QUALITY CONTROL

- .1 Site tests and inspections:
 - .1 Perform in accordance with Section 01 45 00 - Quality Control.
 - .2 Confirm tile is set flush and level with adjacent tiles.
 - .3 Identify broken, cracked, hollow sounding, and damaged tiles.
 - .4 Confirm accessories are installed correctly.
 - .5 Confirm flexible grouting and joint sealants are installed correctly.
 - .6 Confirm installation is complete and in accordance with this section.
- .2 Manufacturer services:
 - .1 Provide manufacturer's site services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .2 Schedule site visits to review work of this section:
 - .1 after delivery and storage of products, and when preparatory work is complete, but before installation begins
 - .1 Arrange for mortar and grout manufacturer's representative to review delivered materials and confirm, in writing, that materials and mixes specified are in accordance with manufacturer's requirements.
 - .2 during mock-up construction
 - .3 during progress of work at approximately 30% and 60% complete
 - .4 upon completion of the work of this section

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning, and:
 - .1 Clean tile surfaces so they are free of foreign matter using manufacturer recommended cleaning products and methods after completing grouting.
 - .2 Remove [latex-Portland cement] [and] [epoxy] 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 instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acidic solution cleaning.
- .4 Flush surface with clean water before and after cleaning.

.2 Waste management:

- .1 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal.

3.9 PROTECTION

- .1 Protect partially installed and completed work from damage in accordance with Section 01 76 00 - Protecting Installed Construction, and:
 - .1 Protect finished tile floor areas from traffic until setting materials have sufficiently cured in accordance with TTMAC Tile Installer Technical Handbook.
 - .2 Prevent foot and wheel traffic from tile floors for minimum 72 hours after completion of grouting.
 - .3 Use stepping boards where access is required for light foot traffic only after 24 hours from completion of grouting.
 - .4 Protect tile flooring from water immersion and freezing for minimum 21 days after completion of tile work.
 - .5 Protect wall tiles and bases from impact, vibration, and heavy hammering on adjacent and opposite walls for a minimum of 14 days after installation.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 21 13 13 - Wet Pipe Sprinkler Systems (specifically sprinkler heads in acoustical panel ceilings)
- .2 Section 23 37 13 - Diffusers, Registers and Grilles (specifically mechanical units in acoustical panel ceilings)
- .3 Section 26 50 00 – Lighting

1.2 DEFINITIONS

- .1 Articulation Classification (AC): Indication of attenuation of sound being reflected from ceiling materials to adjacent areas in open plan areas, in accordance with ASTM E1111/E1111M.
- .2 Ceiling Attenuation Class (CAC): Indication of amount of attenuation of sound passing up through a panel through the open plenum and back down through a panel into adjacent spaces where a partition is not full height, in accordance with ASTM E1414/E1414M.
- .3 Light Reflectance (LR): The percentage amount of light returned from the surface of a material compared to the source.
- .4 Noise Reduction Coefficient (NRC): Measure of the absorption of sound energy over four frequencies. An indication of the amount of noise a panel can absorb - measured in 0.05 increments in accordance with ASTM C423.
- .5 Sound Absorption Average (SAA): Measure of the absorption of sound energy over twelve frequencies. An indication of the amount of sound a panel can absorb - measured in 0.01 increments in accordance with ASTM C423.

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM A580/A580M-18, Standard Specification for Stainless Steel Wire
 - .2 ASTM A641/A641M-19, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 - .3 ASTM C423-17, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - .4 ASTM C635/C635M-17, Standard Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
 - .5 ASTM C636/C636M-19, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
 - .6 ASTM E580/E580M-20 Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions
 - .7 ASTM E1111/E1111M-14, Standard Test Method for Measuring the Interzone Attenuation of Open Office Components
 - .8 ASTM E1264-19, Standard Classification for Acoustical Ceiling Products
 - .9 ASTM E1414/E1414M-21a, Standard Test Method for Airborne Sound Attenuation between Rooms Sharing a Common Ceiling Plenum
 - .10 ASTM E1477-98a, Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers

- .11 ASTM F1667-18a Standard Specification for Driven Fasteners: Nails, Spikes and Staples
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction
- .3 Ceilings & Interior Systems Construction Association (CISCA):
 - .1 Ceiling Systems Handbook, 2019
 - .2 Seismic Construction Handbook, 2018
- .4 CSA Group (CSA):
 - .1 CSA S832-14, Seismic Risk Reduction of Operational and Functional Components (OFCs) of Buildings
- .5 ULC Standards (ULC):
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .2 CAN/ULC-S702.1-14, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification

1.4 COORDINATION

- .1 Do not begin installation of ceiling suspension system until work above ceiling has been reviewed by Consultant.
- .2 Coordinate ceiling work to accommodate components of other Sections built into acoustical ceilings, including the following:
 - .1 Section 21 13 13 - Wet Pipe Sprinkler Systems (specifically sprinkler heads in acoustical panel ceilings).
 - .2 Section 23 37 13 - Diffusers, Registers and Grilles (specifically mechanical units in acoustical panel ceilings)
 - .3 Section 26 50 00 – Lighting

1.5 PRE-INSTALLATION MEETINGS

- .1 Conduct pre-installation meeting in accordance with Section 01 31 19 – Project Meetings at Project site [one] week before beginning [work of this Section] [and] [on-site installation], with Contractor, applicable Subcontractors, and [Departmental Representative] [DCC Representative] [Consultant] to:
 - .1 verify Project requirements,
 - .2 discuss coordination with work of other Sections,
 - .3 review manufacturer's installation instructions [and warranty conditions],
 - .4 discuss and coordinate exact locations of ceiling-mounted components,
 - .5 discuss accepted shop drawings for special installation details, and
 - .6 review existing substrate conditions.

1.6 SEQUENCING

- .1 Schedule installation of acoustical panel ceilings to occur after completion of overhead mechanical and electrical work, where possible.
- .2 Begin installation after building envelope, and dust and moisture producing activities are complete, and paint is dry.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Submit manufacturer's installation instructions, product literature, and data sheets for ceiling suspension system, acoustic panels, and system accessories. Include product characteristics, performance criteria, physical sizes, finishes, and limitations.
- .3 Shop Drawings:
 - .1 Submit reflected ceiling plans for special grid patterns as indicated on Drawings.
 - .2 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, change in level details, access door dimensions and locations, lateral bracing and accessories.
- .4 Samples for Initial Selection:
 - .1 Submit actual samples of acoustical panel that are 150 mm x 150 mm showing full range of colours, textures, and patterns available.
 - .2 Submit samples that are approximately 200 mm long of each ceiling suspension system component exposed to view showing full range of profiles, colours, and gloss levels.
- .5 Samples for Verification:
 - .1 Submit 150 mm x 100 mm samples of each type of acoustic panel.
 - .2 Submit for review and acceptance of each component specified or necessary for complete installation. Include technical descriptive data.
 - .3 Submit samples of each component proposed for use in each type of ceiling suspension system.
- .6 Delegated Design Submittals:
 - .1 Submit delegated design shop drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate that components and installation methods conform to specified seismic design and construction requirements of Contract Documents and in accordance with ASTM E580/E580M.
 - .3 Include supporting details, treatment of cross runners, main runners, and wall closures at terminal ends, suspension wire, lateral force bracing, light fixtures, services within the ceiling, seismic isolation joints, and partition bracing.
- .7 Test Reports: Submit test data indicating that fasteners and anchors used to suspend ceiling systems have a minimum capacity of 890 N in tension, and anchors to attach bracing wires have minimum a capacity of 1960 N in tension.

1.8 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Submit maintenance information for acoustical ceiling systems and incorporate into manual. Include warnings of cleaning methods that may damage finished surfaces.
 - .3 Submit final certificate from design professional responsible for delegated detail design of ceiling indicating conformity with accepted shop drawings.
-

1.9 MAINTENANCE MATERIAL SUBMITTALS

- .1 Supply extra acoustical units in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Supply extra materials from same production run as installed materials.
- .3 Supply acoustical units amounting to 2% of gross ceiling area for each pattern and type of acoustical panel, ceiling suspension system and trim required for Project - minimum one complete factory-sealed package of each.

1.10 QUALITY ASSURANCE

- .1 Certifications:
 - .1 Submit manufacturer's product certificates, certifying materials comply with specified performance criteria and physical requirements.
- .2 Manufacturers: Obtain materials for each type of acoustical panel ceiling system (panels and suspension system) from a single manufacturer. Provide products exposed to view from the same production run for each room, with consistent appearance.

1.11 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:
 - .1 Store materials flat, off ground, indoors, and in a clean, dry, and well-ventilated area.
 - .2 Protect acoustical ceiling components from nicks, scratches, and other damage.

1.12 AMBIENT CONDITIONS

- .1 Unless manufacturer's recommendations are more restrictive, maintain uniform temperature of 15 to 29 degrees C and relative humidity of 20 to 40% for 48 hours before and during installation.
- .2 Store materials in work area 48 hours before beginning installation.

1.13 WARRANTY

- .1 Manufacturer Warranty:
 - .1 Coverage of manufacturing defects in materials and workmanship resulting in failure of suspension system for 30 years from date of Substantial Performance.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

- .1 Superimposed Loads: Determine superimposed loads applied to ceiling suspension systems by components of the building and verify that adequate hangers are installed to support additional loads in conjunction with normal loads of the ceiling system, and as follows:
 - .1 Maximum Deflection: Limit deflection to L/360 in accordance with ASTM C635/C635M deflection test.
 - .2 Seismic Restraints: Design system to withstand seismic forces in accordance with CSA S832 and as outlined in applicable Building Code for normal Importance Category facilities based on a full uniform ceiling load acceleration in accordance with ASTM A580/A580M. Ceiling areas less than 13.4 m² and surrounded by walls connected to structure above do not require seismic restraints.

2.2 MATERIALS

- .1 Classification: Intermediate-Duty system to ASTM C635/C635M

2.3 ACOUSTICAL CEILING SUSPENSION

- .1 Ceiling Suspension System: Non-fire rated, made up as follows:
 - .1 Two-directional exposed tee-bar grid
 - .2 Concealed tee access spline
 - .3 Concealed tongue and groove runner
 - .4 Concealed H-runner, tee spline and flat steel spline
 - .5 Concealed zee runner and flat steel spline
 - .6 [Metal pan special tee system]
- .2 Materials for Suspension System: commercial quality cold rolled steel,
- .3 Exposed Tee-Bar Grid Components: Components die cut. Main tee with double web, rectangular bulb and 24 mm rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection in matching colour to main tees. Shop painted satin sheen, white colour.
- .4 Hanger Wire: To ASTM A641/A641M, galvanized soft annealed steel wire:
 - .1 Access Panel Ceilings: Minimum 3.6-mm diameter
- .5 Hanger Inserts: Purpose made.
- .6 Accessories: Splices, clips, wire ties, retainers and wall moulding [flush] [reveal] to complement suspension system components, and as recommended by system manufacturer.
- .7 Seismic Components and Accessories: In accordance with reviewed shop drawings.

2.4 ACOUSTICAL CEILING PANELS

- .1 Acoustical Panels (ACT-01): to ASTM E 1264-23.
 - .1 Material: Wet-formed Mineral fibre with acoustically transparent water-repellent membrane.
 - .2 Physical Characteristics
 - .1 Type: III (per ASTM E1264)
 - .2 Form: 2 (per ASTM E1264)
 - .3 Pattern: C, E (per ASTM E1264)
 - .4 Size: 610mm x 1220mm
 - .5 Thickness: 16mm
 - .6 Edges: Square, Reveal for 15/16" grid
 - .7 Finished Surface: Painted
 - .8 Finished Surface Color: White
 - .9 Core Composition: Wet-felted mineral fiber
 - .3 Performance Criteria
 - .1 Noise Reduction Coefficient (NRC) per ASTM C423 (E-400 mounting): 0.55
 - .2 Light Reflectance (LR) per ASTM E1477: 0.82
 - .3 Ceiling Attenuation Class (CAC) per ASTM E1414: 35
 - .4 Humidity Resistance
 - .1 Must be installed in controlled conditions for temperature (60-85°F) and relative humidity (less than 70%)
 - .5 Flame Spread Classification per ASTM E84, CAN/ULC-S102: Class A
- .4 Basis of Design: Armstrong Fine Fissured

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verify substrate conditions are acceptable for installation of acoustical ceiling panel and suspension system in accordance with manufacturer's instructions.
 - .1 Visually inspect substrates in presence of Consultant.
 - .2 Inform responsible Subcontractor(s) and Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation after unacceptable conditions are remedied and after receipt of written approval to proceed from Consultant.

3.2 INTERFACE WITH OTHER WORK

- .1 Coordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

3.3 INSTALLATION - SUSPENSION SYSTEM

- .1 Comply with manufacturer's installation instructions and recommendations, including product technical bulletins, installation instructions, and data sheets.
- .2 Install suspension system in accordance with accepted shop drawings, Certification Organizations tested design requirements and ASTM C636/C636M except where specified otherwise.
- .3 Install suspension system by suspending ceiling hangers from building's structural members, and as follows:
 - .1 Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - .2 Attach hangers to structural members or intermediate structural supports.
 - .3 Fasten hangers to cast-in-place hanger inserts, powder actuated fasteners, or drilled in anchors that extend through forms into concrete.
 - .4 Splay hangers only where required to miss obstructions. Offset resulting horizontal forces by bracing or counter-splaying.
- .4 Lay out system according to reflected ceiling plan.
- .5 Installation Tolerances: Finished ceiling system square with adjacent walls and level within 1:1000.
- .6 Secure hangers to overhead structure using attachment methods acceptable to Consultant.
- .7 Install hangers spaced at a maximum 1200 mm on centre and within 150 mm from ends of main tees.
- .8 Coordinate suspension system with location of related components. Provide carrying channels as necessary to bridge at unavoidable interference between suspension system and other work above ceiling.
- .9 Install wall moulding to provide correct ceiling height.
- .10 Completed suspension system to support super-imposed loads, such as lighting fixtures, diffusers, grilles.
- .11 Support light fixtures, diffusers with additional ceiling suspension hangers within 150 mm of each corner and at a maximum 610 mm around perimeter of fixture.

- .12 Interlock or attach cross member to main runner to provide rigid assembly.
- .13 Frame at openings for light fixtures, air diffusers, speakers, and at changes in ceiling heights.
- .14 Install access splines to provide 50% ceiling access.
- .15 Install perimeter trim at floating installations securely anchored to suspension system, in accurate alignment with adjacent assemblies. Install curved trim members in smooth curves to radius indicated.

3.4 INSTALLATION - ACOUSTICAL CEILING PANEL SYSTEM

- .1 Install lay-in acoustical panels in ceiling suspension system in accordance with manufacturer's instructions and as indicated.
- .2 Install panels with edges fully hidden from view by flanges of suspension system runners and mouldings.
- .3 Install fibrous acoustical media [and spacers] over entire area above [suspended metal panels].
- .4 In fire-rated ceiling systems, secure lay-in panels with hold-down clips and protect over light fixtures, diffusers, air return grilles and other appurtenances according to Certification Organizations design requirements.

3.5 SITE QUALITY CONTROL

- .1 Site Tests and Inspections: Arrange for periodic site visits by design professional responsible for delegated ceiling design work to review installed work for conformity to design.
- .2 Manufacturer Services: Arrange for periodic site visits by manufacturer's representative to review installed work for conformity to manufacturer's installation instructions and recommendations.
 - .1 Submit written site reports within [three] days of visit.
- .3 Non-Conforming Work:
 - .1 Do not support ceilings directly from permanent metal forms, floor deck, or other non-structural framing.
 - .2 Do not attach hangers to steel roof deck or steel deck tabs.
 - .3 Do not level ceilings by putting kinks in suspension wires. Kinks in suspension wires are not acceptable.
 - .4 Conceal fasteners including pop rivets on mouldings and trims.

3.6 CLEANING

- .1 Progress Cleaning: In accordance with Section 01 74 00 - Cleaning.
- .2 Final Cleaning: In accordance with Section 01 74 00 – Cleaning, and touch-up scratches, abrasions, voids, and other defects in painted surfaces.

3.7 PROTECTION

- .1 Protect installed products from damage during construction.
- .2 Repair damage to adjacent materials caused by acoustical suspension installation.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Luxury Vinyl Tile flooring.
 - .2 Resilient static dissipative tile flooring.
 - .3 Resilient base.

1.2 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete
- .2 Section 08 71 00 - Door Hardware
- .3 Section 09 30 13 - Ceramic Tiling
- .4 Section 09 68 13 - Tile Carpeting
- .5 Section 22 05 15 - Plumbing Specialties and Accessories
- .6 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings

1.3 REFERENCE STANDARDS

- .1 American Association of Textile Chemists and Colorists (AATCC):
 - .1 AATCC 134-2019, Test Method for Electrostatic Propensity of Carpets
- .2 ASTM International (ASTM):
 - .1 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials
 - .2 ASTM F150-06, Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring
 - .3 ASTM F710-21, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
 - .4 ASTM F1066-04, Standard Specification for Vinyl Composition Floor Tile
 - .5 ASTM F1344-21a, Standard Specification for Rubber Floor Tile
 - .6 ASTM F1482-21, Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
 - .7 ASTM F1700-20, Standard Specification for Solid Vinyl Floor Tile
 - .8 ASTM F1861-21, Standard Specification for Resilient Wall Base
 - .9 ASTM F1869-23, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
 - .10 ASTM F2169-15, Standard Specification for Resilient Stair Treads
 - .11 ASTM F2170-19A, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
 - .12 ASTM F2195-18, Standard Specification for Linoleum Floor Tile
 - .13 ASTM F2471-19, Standard Practice for Installation of Thick Poured Lightweight Cellular Concrete Underlayments and Preparation of the Surface to Receive Resilient Flooring
 - .14 ASTM F2873-20, Standard Practice for the Installation of Self-Leveling Underlayment and the Preparation of Surface to Receive Resilient Flooring
 - .15 ASTM F3008-20, Standard Specification for Cork Floor Tile
 - .16 ASTM F3010-18, Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings

- .17 ASTM F3191-23, Standard Practice for Field Determination of Substrate Water Absorption (Porosity) for Substrates to Receive Resilient Flooring
- .18 ASTM F3041-14, Standard Specification for Bonded Rubber Crumb Floor Coverings
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors
 - .2 CAN/CGSB-25.21-95, Detergent-Resistant Floor Polish
- .4 CSA Group (CSA):
 - .1 CSA A23.1:19/A23.2:19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
 - .2 CSA B651-18, Accessible Design for the Built Environment
- .5 EOS/ESD Association (ESD):
 - .1 ANSI/ESD STM7.1-2020, Protection of Electrostatic Discharge Susceptible Items - Flooring Systems Resistive Characterization
 - .2 ANSI/ESD S20.20-2021, Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
- .6 General Services Administration, Federal Test Standard (FTS):
 - .1 FTS 101C, Method 4046, Electrostatic Properties of Materials
- .7 National Floor Covering Association (NFCA):
 - .1 Floor Covering Reference Manual, current edition
 - .2 Quality Assurance Program (QAP)
- .8 South Coast Air Quality Management District (SCAQMD):
 - .1 SCAQMD Rule 1168-A2022, Adhesive and Sealant Applications
- .9 ULC Standards (ULC):
 - .1 CAN/ULC S102.2:2018, Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with Section 03 30 00 - Cast-in-Place Concrete for concrete floor flatness and levelness tolerances.
 - .2 Coordinate with Section 03 30 00 - Cast-in-Place Concrete for concrete curing materials and methods that are compatible with adhesives used for resilient tile installation. [Minimize surface-applied curing compounds, sealers/hardeners, and moisture retarders that may be detrimental to resilient tile adhesive bond strength.]
 - .3 Coordinate with Section 08 71 00 - Door Hardware for door thresholds.
 - .4 Coordinate with Section 09 68 13 - Tile Carpeting for edge strip installation where resilient tile flooring is adjacent to carpet.
 - .5 Coordinate with Section 09 30 13 - Ceramic Tiling for installation of edge strips and transition strips adjacent to ceramic tile.
 - .6 Coordinate with Section 22 05 15 - Plumbing Specialties and Accessories] for installation of floor drains, trenches, and clean-outs.
 - .7 Coordinate with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings for installation of floor outlets and boxes for power and communications.

- .2 Pre-installation meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings, attended by Consultant, manufacturer's services representative, and related Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review installation and substrate conditions, including flatness and levelness.
 - .4 Coordination with other Subcontractors.
 - .1 Coordinate connection of copper grounding strips with electrical installer.
 - .5 Review manufacturer's installation instructions and warranty requirements.
 - .6 Review NFCA QAP inspection procedures and reports and timing of reports for multi-phase projects.
- .3 Sequencing: Install flooring after painting, ceiling work, and other overhead work are complete.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit the following action submittals before starting work of this section:
 - .1 Product data: Product literature and data sheets for installed products, including product characteristics, performance criteria, physical sizes, finishes, WHMIS SDS, and limitations.
 - .2 Samples: Full range of samples, for each product specified, including edge strips, reducer strips, and transition strips, representing available colours, patterns, textures, profiles, and finishes.
 - .1 100mm x 100mm samples of each type of resilient sheet flooring.
 - .2 50mm long sections of resilient base, full profile height.
 - .3 Manufacturer's standard-size samples of other accessories exposed to view.
 - .3 Site quality control submittals: In accordance with NFCA QAP procedures and requirements.
 - .1 Submit floor pre-installation test results before beginning flooring installation. Compare tested moisture vapour emission rates and alkalinity with manufacturer's requirements for each flooring type.
 - .2 Submit manufacturer's recommended corrective actions when pre-installation test results deviate from manufacturer's installation requirements.
- .3 Submit the following informational submittals as work progresses:
 - .1 Manufacturer's instructions: Indicate special storage and handling requirements, installation instructions and sequence, and cleaning procedures[; keep a copy on site during installation].
 - .2 Manufacturer site reports: Manufacturer's reports confirming work of this section complies with manufacturer's requirements for handling, installation, protection, and cleaning, as specified in SITE QUALITY CONTROL in this section; submit within 5 working days of site visit.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Operation and maintenance data: Include, in the operation and maintenance manual, manufacturer's maintenance instructions and recommended cleaning materials and methods.
 - .3 Bonds: Two-year maintenance bond for 100% value of work of this section.
 - .4 Warranty documentation: Submit manufacturer's warranties.
-

1.7 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra stock materials: In accordance with Section 01 78 00 - Closeout Submittals.
- .2 Supply minimum 2% of each colour, pattern, texture, and type of resilient tile flooring material in full sizes.
 - .1 Label each box of tile flooring; match designations indicated [on Drawings] [as scheduled].
- .3 Supply minimum 4L of each adhesive. Store in sealed, labelled containers.
- .4 Supply minimum 50m of resilient base, in each specified colour and height.

1.8 QUALITY ASSURANCE

- .1 Perform work of this section in accordance with NFCA QAP requirements.
- .2 Qualifications:
 - .1 Installers: Experienced in resilient tile flooring installations with three years documented successful installations, with manufacturer's training or certification program.
 - .2 Installers: Experienced in work of this section, with three years of documented successful installations, and with manufacturer's training or certification.
 - .3 Installers: Member in good standing with National Floor Covering Association (NFCA) or Resilient Flooring Contractors Association of Ontario (RFCOA) throughout the performance of the Work and employs Red Seal Floorcovering Installers.
 - .4 Installers: Apprentices are acceptable when under direct supervision of qualified journey person in accordance with applicable trade regulation.

1.9 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements, and:
 - .1 Protect adhesives, sealers, and sealants from freezing.
 - .2 Coordinate delivery of materials with scheduled installation to allow minimum conditioning time on site.

1.10 SITE CONDITIONS

- .1 Ambient conditions: Maintain specified ambient conditions, or more stringent manufacturer requirements, for 72 hours before installation, continuously during installation, and 72 hours after installation.
 - .1 Ambient room temperature: 18°C to 29°C.
 - .2 Floor substrate temperature: Minimum 15°C.
 - .3 Relative humidity: 40% to 60%.
- .2 Extra ventilation: Provide high ventilation rate, maximizing outside air, during installation and for 48 to 72 hours after installation. If possible, vent directly to outside. Prevent contaminated air recirculation through interior air distribution system. Maintain extra ventilation for at least one month following building occupancy.

1.11 WARRANTY

- .1 Manufacturer warranty: 5-year warranty.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- .1 Meet requirements of CAN/ULC S102.2 for required flame-spread ratings, labelled and listed by ULC or another agency acceptable to authority having jurisdiction.

2.2 SUSTAINABILITY CHARACTERISTICS

- .1 VOC emissions for adhesives, sealants, primers, and coatings: 50g/L to SCAQMD Rule 1168.
- .2 Chemical component restrictions for adhesives, sealants, primers, and coatings:.

2.3 PERFORMANCE CRITERIA

- .1 Preparation, materials, and workmanship in accordance with NFCA QAP requirements.
- .2 Provide static dissipative tile flooring as a complete system with accessories, specialty adhesive, copper grounding strips, and maintenance finish from a single manufacturer with the following static performance requirements:
 - .1 Dissipative flooring:
 - .1 Resistivity range: 1.0×10^6 to 1.0×10^9 ohms to ASTM F150.
 - .2 Static generation: Less than 100 V when tested in accordance with AATCC-134.
 - .3 Static decay: 5000 V to 0 V in less than 0.2 seconds in accordance with Federal Test Method 4046-101C.

2.4 RESILIENT TILE FLOORING MATERIALS

- .1 FloorScore certified.
- .2 Static Dissipative Solid vinyl tile: To ASTM F1700.
 - .1 Class: I – Monolithic.
 - .2 Type: A – Smooth surface.
 - .3 Wear layer: Suitable for commercial applications.
 - .4 Thickness: 2 mm.
 - .5 Size: 610 x 610 mm nominal.
 - .6 Colours: As selected by Consultant from manufacturer's complete range.
- .3 Luxury Vinyl Tile Flooring to ASTM F1700, Type III Type B. characteristics as follows:
 - .1 Size: 184.2 mm x 1219.2 mm
 - .2 Total Thickness: 2 mm.
 - .3 Wear Layer Thickness: 0.55mm minimum.
 - .4 Edge Treatment: Square Edge (SE)
 - .5 Standard Emboss.
 - .6 Fire Performance: Flooring material shall meet the following fire test performance criteria as tested by a recognized independent testing laboratory:
 - .1 ASTM E648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I.
 - .2 ASTM E662 (Smoke Generation) Maximum Specific Optical Density of 450 or less.
 - .3 Calories and pattern detail shall be dispersed throughout the thickness of the wear layer.
 - .7 Sustainable properties:
 - .1 FloorScore Certified or equivalent.
 - .2 Minimum 60% recycled content.
 - .3 Compliant with Comply with Section 01 35 21 – Sustainable Requirements.
 - .8 Basis of Design:
 - .1 Code **LVT-1**: Polyflor, Style: Affinity 255 PUR, Colour: 9875 Dappled Oak

.2 Code LVT-2: Polyflor, Style: Affinity 255 PUR, Colour: 9872 Planed White Oak

2.5 WALL BASE

- .1 Resilient base: To ASTM F1861, with manufacturer's pre-moulded end stops and external corners, same dye lot for entire Project.
 - .1 Type: TS - Rubber, Vulcanized Thermoset.
 - .2 Group: 1 – Solid.
 - .3 Style: B - Coved.
 - .4 Thickness: 2.0mm.
 - .5 Height: 100mm.
 - .6 Lengths: Manufactured in continuous rolls or manufactured in standard lengths minimum 2400 mm long.
 - .7 Colour: As selected by Consultant] from manufacturer's complete range.
 - .1 FloorScore certified.

2.6 ACCESSORIES

- .1 Primer: Where recommended by sheet flooring manufacturer for site conditions and application.
- .2 Concrete moisture emission reducer coating: Moisture insensitive, epoxy modified, forming a permanent moisture barrier, water vapour permeability less than 6 ng/Pa·s·m when tested to ASTM E96/96M (wet method). Other test methods will be considered.
- .3 Adhesives: Types recommended by flooring manufacturer for substrate; above, on, or below grade.
 - .1 Cove base adhesives: Type recommended by base manufacturer to suit application.
 - .2 Static conductive flooring adhesive: Full spread adhesive, specially formulated for static conductive flooring, and as recommended by sheet flooring manufacturer for application.
- .4 Copper grounding strips: As recommended by electrostatic dissipative flooring manufacturer.
- .5 Sub-floor filler and leveller: Pre-mix latex requiring water only to produce cementitious pastes as recommended by flooring manufacturer for use with their product.
- .6 Metal transition and edge strips: Meeting CSA B651 for height and slope, [extruded aluminum] [stainless steel], [mill finish] [polished] with lip to extend under sheet flooring, shoulder flush with top of adjacent floor finish.
 - .1 Colour: As selected by Consultant.
- .7 Resilient transition and edge strips: Meeting CSA B651 for height and slope, extruded aluminum.
 - .1 Colour: As selected by Consultant.
- .8 Edging to floor penetrations: Aluminum, profile recommended by resilient tile flooring manufacturer.
- .9 Sealer: To CAN/CGSB-25.20, Type 2-water based and as recommended by resilient tile flooring manufacturer.
- .10 Wax: Type recommended by flooring manufacturer, and compatible with finish materials used by DCC accommodation maintenance forces.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions: Verify conditions in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Concrete floors are free of cracks, ridges, and depressions.
 - .2 Concrete surface profile is within resilient tile flooring manufacturer's recommendations and CSP 2 to ICRI 310.2.
 - .3 Subfloor is free of squeaks when walking across floor.
 - .4 Painting and ceiling work is complete.
- .2 Pre-installation testing: Perform tests to verify concrete floors are dry, with moisture vapour emission rate and alkalinity within the manufacturer's recommendations. Perform tests to ASTM F2170 or ASTM F1869, except where resilient tile flooring manufacturer recommends more stringent test methods and requirements. Notify Consultant of testing date so they may choose to attend at their discretion.
 - .1 Perform tests before installation of subsequent products (hydraulic cement underlayment, fillers, patching materials, adhesives, etc.).
 - .2 Test substrate moisture vapour emissions to ASTM F710. Perform a minimum three tests for the first 100 m² and one additional test per 100 m² of additional floor area with one test within 1.0 m of an exterior wall for concrete slabs-on-grade.
 - .3 Test substrate alkalinity to ASTM F710, pH range of 7 to 9. Perform one test per 100 m² of floor area.
 - .4 Test substrate porosity to ASTM F3191 using test method recommended by resilient tile flooring manufacturer.
 - .5 Perform adhesive bond test to cleaned 1.0 x 1.0 m concrete substrate in accordance with, unless otherwise recommended by floor covering manufacturer, and allow to cure for 72 hours before evaluating bond strength.

3.2 PREPARATION

- .1 Protection of in-place conditions: Protect face of doors, door frames, and walls from marring due to installation of resilient tile flooring.
- .2 Surface preparation: In accordance with NFCA Floor Covering Reference Manual, Part A13 and ASTM F710 for concrete floors and ASTM F2873 and ASTM F2471, manufacturer's instructions.
 - .1 Remove or treat old adhesives to prevent residual, old flooring adhesives from bleeding through to new flooring and interfering with the bonding of new adhesives.
 - .2 Remove pen and marker lines completely from concrete surfaces.
 - .3 If concrete floor substrate vapour emissions exceed manufacturer's recommendations, prepare substrate in accordance with ASTM F3010.
 - .4 Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with subfloor filler.
 - .5 Where floor substrate flatness and levelness tolerances do not meet minimum requirements to begin installation of resilient tile flooring, prepare substrate in accordance with ASTM F2873, ASTM F2471, NFCA Floor Covering Reference Manual.
 - .6 Clean floor of dust, mould, mildew, alkaline salts, laitance, concrete film-forming curing compounds, paint, solvents, wax, oil, grease, residual adhesive, adhesive removing compounds, sealants, soap, and other foreign material.
 - .7 Fill low spots, cracks, joints, holes and other defects with subfloor filler in accordance with ASTM F2873, ASTM F2471. Trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler is cured.
 - .8 Seal concrete slab to resilient tile flooring and adhesive manufacturer's recommendations.
 - .9 Vacuum substrates.

.10 Do not use permanent markers on floor substrates.

- .3 Apply copper grounding strips to substrate and connect to pre-determined grounding point. Coordinate connection with Consultant and electrical Subcontractor.

3.3 INSTALLATION – RESILIENT TILE

- .1 Install resilient tile flooring and accessories using tools, materials, methods, and sequence of work to NFCA Floor Covering Reference Manual recommendations and manufacturer's recommendations.
- .2 Mix and apply adhesive uniformly in accordance with manufacturer's instructions, using manufacturer-recommended trowel notching, spread, coverage rate, open times, and safety precautions. Do not spread more adhesive than can be covered by flooring before initial set. Applying adhesive only at perimeter is not acceptable.
- .3 Lay flooring with joints parallel to building lines to produce symmetrical tile pattern. [Border tiles minimum half tile width, but not less than 150 mm wide.
- .4 Install flooring to square grid pattern.
- .5 Cut resilient tile and fit neatly around fixed objects.
- .6 Cut resilient tile to fit tightly in pan type floor access covers and to frames, using hardware cut-outs.
- .7 Install resilient tile flooring in areas which will be under built-in furniture.
- .8 Install resilient tile flooring through areas to receive movable type partitions without interrupting floor pattern.
- .9 Install resilient tile flooring through doorways and scribed to fit projections and vertical surfaces.
- .10 Terminate flooring under centreline of door, in openings where adjacent floor finish material or colour are dissimilar.
- .11 During and after installation, roll flooring in two directions with minimum weighted roller to achieve full adhesion and prevent visible adhesive or trowel marks, unless otherwise indicated by flooring manufacturer.
- .12 Install edge strips at floor penetrations, and edge strips at unprotected and exposed edges where flooring terminates to suit conditions. Securely bond to substrate and in a straight line.
- .13 When necessitated by material size, locate cross seams and seams at doors and pivot points in accordance with accepted shop drawings.
- .14 Apply waterproof sealant at edge of linoleum abutting walls, millwork bases, and other projections in wet areas.

3.4 INSTALLATION – WALL BASE

- .1 Lay out resilient base with minimum number of joints.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Set resilient base against wall and floor surfaces tightly by using 3-kg hand roller.
- .4 Install straight and level to variation of 1:1000.

- .5 Scribe, cut, and fit wall base to door frames and other obstructions. Install pre-moulded end pieces at flush door frames.
- .6 Install pre-moulded wall base corner units for right angle external and internal corners. Install formed straight wall base for non-90 degree corners.

3.5 APPLICATION - FINISHES

- .1 Seal and wax floors to resilient tile flooring manufacturer's instructions.

3.6 SITE QUALITY CONTROL

- .1 Manufacturer's site services:
 - .1 Provide manufacturer's site services consisting of periodic site visits to inspect product installation in accordance with manufacturer's instructions.
 - .2 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, protecting and initial cleaning of product and submit Manufacturer's Site Reports.
 - .3 For specialty resilient flooring materials or systems, the manufacturer's representative shall review all substrates and conditions for material applications and provide sufficient site reviews and reports to verify installation conforms with product warranty.

3.7 ADJUSTING

- .1 Repair or replace deficient work in accordance with NFCA QAP requirements.

3.8 CLEANING

- .1 Cleaning: Perform in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove excess adhesive before cured.
- .2 Waste management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal.

3.9 CLOSEOUT ACTIVITIES

- .1 Demonstration and training: Perform in accordance with Section 01 79 00 - Demonstration and Training.
 - .1 Recommend cleaning and finishing products to suit site conditions and application and that will not affect flooring slip-resistance and static control qualities.
 - .2 Demonstrate periodic cleaning methods for each resilient flooring type.

3.10 PROTECTION

- .1 Protect flooring with non-marring temporary coverings until Substantial Performance.
- .2 Prohibit traffic on resilient tile flooring for a minimum 48 hours after installation.
- .3 Protect resilient tile flooring from heavy rolling loads during construction with plywood, hardboard, or other protection method recommended by resilient tile flooring manufacturer.
- .4 Allow a minimum 24 hours for site-applied finishes to dry before permitting foot traffic and a minimum 7 days before placing furniture and similar heavy objects.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 07 14 00 Fluid Applied Waterproofing
- .2 Section 09 21 16 Gypsum Board Assemblies

1.2 REFERENCES

- .1 American National Standards Institute
 - .1 ANSI A326.3-2021 American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Material.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM C307-18 Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
 - .2 ASTM C413-18 (2023) Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
 - .3 ASTM C579-23 Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
 - .4 ASTM C580-18 (2023) Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
 - .5 ASTM D2240-15 (2021) Standard Test Method for Rubber Property—Durometer Hardness
 - .6 ASTM D2794-93 (2024) Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
 - .7 ASTM D4060-25 Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
 - .8 ASTM D4541-22 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
 - .9 ASTM D7234-22 Standard Test Method for Pull-Off Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
 - .10 ASTM C834-10, Standard Specification for Latex Sealants.
 - .11 ASTM C920-14a, Standard Specification for Elastomeric Joint Sealants.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS).
- .4 International Concrete Repair Institute (ICRI)
 - .1 ICRI Concrete Surface Profile Standard (Guideline 310.2R - 2013)
 - .2 Guidelines, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays. Guideline No. 03732 - 2002

1.3 SUBMITTALS

- .1 Product Data: Submit manufacturer's technical data, installation instructions, and general recommendations for each resinous flooring material required. Include certification indicating compliance of materials with project requirements.
- .2 Samples: Submit, for verification purposes, 4-inch square samples of each type of resinous flooring material required, applied to a rigid backing, in color and finish indicated.

- .3 For initial selection of colors and finishes, submit manufacturer's color charts showing full range of colors and finishes available.
- .4 For initial selection of texture, submit manufacturer's texture samples showing full range of slip resistant textures available.
- .5 Submit a letter from the manufacturer certifying that the installer is still an "approved applicator" and fully trained in the installation of the specified materials.

1.4 QUALITY ASSURANCE

- .1 The work associated with this section should be performed by a company with a minimum of five years experience in applying this type of floor covering. The installer must be an "approved applicator" of the material manufacturer.
- .2 Pre-Installation Conference
 - .1 General contractor shall arrange a meeting not less than thirty days prior to starting work.
 - .2 Attendance
 - .3 General Contractor
 - .4 Architect/Owner's Representative
 - .5 Manufacturer/Installer's Representative
- .3 Manufacturer's representative shall be present at all construction phases to ensure adequate control on the installation.
- .4 ISO 9001: All materials, including primers, resins, curing agents, finish coats, aggregates and sealants are manufactured and tested under an ISO 9001 registered quality system.
- .5 Before work begins, alternative installation procedures and recommendations must be submitted to and approved by the project consultant.
- .6 Check the thickness of the flooring system once it has cured at random locations determined by the project consultant. Fill in the areas that have been checked until they are flush with the rest of the floor.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Material shall be delivered to job site and checked by flooring contractor for completeness and shipping damage prior to job start.
- .2 All materials used shall be factory blended and packaged in single, easy to manage batches to eliminate on site blending errors. Only the on-site weighing of catalyst will be allowed.
- .3 Material shall be stored in a dry, enclosed area protected from exposure to moisture. Temperature of storage area shall be maintained between 60 and 77°F/16 and 25°C.

1.6 PROJECT CONDITIONS

- .1 Concrete or masonry substrates shall be properly cured for a minimum of 30 days and shall be tested to ensure relative humidity or water vapour emission rates are in accordance with Manufacturer's recommendations. A vapor barrier or exterior applied waterproofing membrane must be present for concrete slabs below grade.
 - .2 Utilities, including electric, water, heat (air temperature between 60 and 77°F/16 and 25°C) and finished lighting to be supplied by General Contractor.
 - .3 Job area to be free of other trades during, and for a period of 24 hours, after flooring system installation.
-

- .4 Protection of finished flooring system from damage by subsequent trades shall be the responsibility of the General Contractor.
- .5 Provide adequate ventilation to prevent migration of fumes.

1.7 WARRANTY

- .1 Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of three (3) full year from date of installation.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 This specification is based on 'Sika' Floor and Wall Systems.
- .2 At the request of the consultant assigned to the project, a technical representative from Sika Canada Inc. will be available on three days notice to assist and advise during the installation of the flooring system to ensure that the applicator complies with the manufacturer s installation recommendations Source Limitations:
- .3 Equivalent products may only be substituted at the review and acceptance of the consultant.
- .4 Obtain Coatings products of each type from single source from single manufacturer.

2.2 RESINOUS FLOORING SYSTEM

- .1 Screed – medium-duty and thermal shock resistant, self levelling polyurethane/cement screed.
 - .1 Physical Properties:
 - .1 Shore D Hardness (ASTM D2240): 83
 - .2 Compressive Strength (ASTM C579): 39 MPa (5657 psi) after 28 days
 - .3 Tensile Strangth (ASTM C307): 6.51 MPa (944 psi)
 - .4 Tensile Strength in flexure (ASTM C580): 14.6 MPa (2118 psi)
 - .5 Modulus of Elasticity in Flexure (ASTM C580): 1871 MPa (271,425 psi) at 14 days
 - .6 Pull-Off Strength (ASTM D7234): 3 MPa (435 psi)
 - .7 Water Absorption (ASTM C413): 0.45%
 - .8 Applied Thickness: 4.5 – 6mm
 - .2 Basis of Design: Sikafloor -22 NA PurCem
- .2 Top Coat – uv resistant, high-build, solvent-free aliphatic polyurethane/cement top coat.
 - .1 Physical Properties:
 - .1 Shore Hardness (ASTM D2240): 81
 - .2 Abrasion Resistance (ASTM D4060): 0.08g (CS17/1000cycles/1000g (2.2lbs) / 0.153g (H-22/1000cycles/1000g (2.2lbs)
 - .3 Tensile Strength (ASTM C307): 15 MPa (2,231 psi)
 - .4 Tensile Strength in Flexure (ATM C580): 31.8 MPa (4,613 psi)
 - .5 Pull-Off Strength (ASTM D7234): > 3.0 MPa (>435 psi)
 - .6 Water Absorption (ASTM C413): 0.68% (2 hours boiling)
 - .7 Coefficient of Friction (ANSI A326.3 or DCOF – BOT 3000e)
 - .1 Wet: 0.60
 - .8 Applied Thickness: 10-20 mils
 - .9 Color: RAL 7038 Agate Grey.
 - .2 Basis of Design: Sikafloor- 33 NA PurCem

2.3 INTEGRAL COVE BASE:

- .1 Primer for cove base: a two-component, epoxy resin-based, thixotropic primer and binder specially designed for coving and other vertical applications.
 - .1 Physical Properties:
 - .1 Shore Hardness (ASTM D2240): 80
 - .2 Abrasion Resistance (ASTM D4060): 2.8g (H-20/1000cycles/1000g)
 - .3 Resistance to Impact (ASTM D2794): 3.55 joules (2.62 ft lb)
 - .4 Compressive Strength (ASTM C579): 54 MPa (7,832 psi)
 - .5 Tensile Strength (ASTM C307): 14 MPa (2,031 psi)
 - .6 Tensile Strength in flexure (ASTM C307): 14.7 MPa (2132 psi)
 - .7 Pull-Off Strength (ASTM D4541): >5 MPa (725 psi)
 - .2 Characteristics:
 - .1 Height: 152mm (6")
 - .2 Radius: 25.4mm (1") radius epoxy mortar cove keyed into the concrete substrate at the juncture of the floor and the wall.
 - .3 Basis of Design: Sikafloor-293
- .2 Mortar for Cove Base: Two component epoxy-resin based thixotropic binder mixed with aggregate.
 - .1 Basis of Design: Sikafloor -293 mixed with Sika Aggregate PT in a ratio as recommended by manufacturer.
- .3 Top Coat – UV resistant, high-build, solvent-free aliphatic polyurethane/cement top coat.
 - .1 Physical Properties:
 - .1 Shore Hardness (ASTM D2240): 81
 - .2 Abrasion Resistance (ASTM D4060): 0.08g (CS17/1000cycles/1000g (2.2lbs) / 0.153g (H-22/1000cycles/1000g (2.2lbs)
 - .3 Tensile Strength (ASTM C307): 15 MPa (2,231 psi)
 - .4 Tensile Strength in Flexure (ATM C580): 31.8 MPa (4,613 psi)
 - .5 Pull-Off Strength (ASTM D7234): > 3.0 MPa (>435 psi)
 - .6 Water Absorption (ASTM C413): 0.68% (2 hours boiling)
 - .7 Coefficient of Friction (ANSI A326.3 or DCOF – BOT 3000e)
 - .1 Wet: 0.60
 - .8 Applied Thickness: 15-20 mils
 - .9 Color: RAL 7038 Agate Grey.
 - .2 Basis of Design: Sikafloor- 33 NA PurCem

2.4 ADDITIONAL MATERIALS:

- .1 Joint Filler to ASTM C920, Type S, Grade P, Class 25, and as recommended by the manufacturer of the specified product.

2.5 JOINT SEALANT

- .1 Type produced by manufacturer of resinous flooring system for type of service and joint condition indicated.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Existing Epoxy Substrate: Existing epoxy substrate shall be removed by mechanical means and may include use of diamond grinder, sander, and / or other mechanical means for removing existing material to the satisfaction of the coating manufacturer's representative.

- .2 Concrete Substrate: The concrete surface must be dry, clean and sound. Remove all traces of dust, laitance, grease, oil, dirt, curing or impregnation agents, wax, foreign substances, coatings and loose material from the surface using appropriate mechanical means and may include use of diamond grinder, sander, shotblast method and / or other mechanical means. Prepare concrete surface to ICRI Concrete Surface Profile 3 to 6 prior to coating application
- .3 Cover adjacent surfaces, fixed accessories and equipment with protective sheeting or other suitable means to prevent damage from splashes, spills or any other damage that may occur during the work.
- .4 Cut an anchor groove 100 mm (4") before each screed stop, drain, channel and connection point. The groove must be 8 mm (3/8") wide and twice as deep as the thickness of the floor covering.
- .5 At all ends that do not terminate at a wall or edge, avoid reducing the thickness. Maintain a minimum thickness of 4.5 mm (3/16 in) around drains, channels and any openings in the floor.
- .6 Unstabilised cracks and expansion joints must be extended into the flooring system and filled with a flexible product as recommended by the flooring manufacturer.

3.2 APPLICATION

- .1 General: Apply each component of resinous flooring system in compliance with manufacturer's directions to produce a uniform monolithic surface of thickness indicated, uninterrupted except at expansion joints or other types of joints (if any), indicated or required.
- .2 Screed: Mix and apply screed over properly prepared concrete substrate in accordance with manufacturers written instructions. Apply Screed to a thickness of 4.5 mm – 6 mm thick.
- .3 Primer: Mix and apply primer over properly prepared substrate with strict adherence to manufacturer's installation procedures and coverage rates. Apply primer in one coat at 8-10 mils thickness immediately after mixing using high quality medium nap rollers. Coordinate timing of primer application with application of flooring system to ensure optimum inter-coat adhesion.
- .4 Mortar Cove Base: mix and apply resin with aggregate in compliance with manufacturer's written instructions. Apply vertical application to 6mm (1/4") thick. Create cove with 25mm (1") radius.
- .5 Topcoat: Mix material according to manufacturer's recommended procedures. Topcoat material shall be applied in two coats at 5-10 mils per coat immediately after mixing using high quality medium nap rollers. Strict adherence to manufacturer's coverage rates shall be maintained.
- .6 Finish coat: Mix and roller apply the topcoat with strict adherence to manufacturer's installation procedures and coverage rates.

3.3 FIELD QUALITY CONTROL

- .1 The right is reserved to invoke the following material testing procedure(s) at any time, and any number of times during period of flooring application.
- .2 The Owner will engage service of an independent testing laboratory to sample materials being used on the job site. Samples of material will be taken, identified and sealed, and certified in presence of Contractor.
- .3 Testing laboratory will perform tests for any of the specified characteristics, using applicable testing procedures referenced herein, or if none referenced, in manufacturer's product data.

- .4 The General Contractor shall engage service of an independent coating inspector to perform core tests to verify installation thickness meets the requirements of the specification. Installer shall repair to the Architect's satisfaction any damage in the flooring system.
- .5 If test results show materials being used do not comply with specified requirements, flooring contractor may be directed by Owner to stop work; remove non-complying materials; pay for testing; reapply flooring materials to properly prepared surfaces which had previously been coated with unacceptable materials.

3.4 CURING, PROTECTION AND CLEANING

- .1 Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours after application.
- .2 Protect flooring system from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor shall be responsible for protection and cleaning of surfaces after final coats.
- .3 Protect the finished floor from chemicals until it has fully cured for approximately 5 days at 20° C.
- .4 Cleaning: Remove temporary covering and clean resinous flooring system prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring system manufacturer. General Contractor shall be responsible for cleaning of the surfaces prior to inspection.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 09 65 19 - Resilient Tile Flooring

1.2 REFERENCE STANDARDS

- .1 American Association of Textile Chemists and Colorists (AATCC):
 - .1 AATCC Test Method 16.1-2023, Colorfastness to Light: Outdoor
 - .2 AATCC Test Method 16.2-2023e, Colorfastness to Light: Carbon-Arc
 - .3 AATCC Test Method 16.3-2020, Colorfastness to Light: Xenon-Arc
 - .4 AATCC Test Method 23-2015e, Colorfastness to Burn Gas Fumes
 - .5 AATCC Test Method 129-2011e, Colorfastness to Ozone in the Atmosphere Under High Humidities
 - .6 AATCC Test Method 134-2019, Electrostatic Propensity of Carpets
 - .7 AATCC Test Method 138-2000e, Cleaning: Washing of Textile Floor Coverings
 - .8 AATCC Test Method 165-1999e10, Test Method for Colorfastness to Crocking: Textile Floor Coverings-Crockmeter
 - .9 AATCC Test Method 174-2022e, Antimicrobial Activity Assessment of New Carpets
 - .10 AATCC Test Method 175-2024, Stain Resistance: Pile Floor Coverings
- .2 ASTM International (ASTM):
 - .1 ASTM D1335-21, Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings
 - .2 ASTM D1667-22, Standard Specification for Flexible Cellular Materials-Poly (Vinyl Chloride) Foam (Closed-Cell)
 - .3 ASTM D3574-17, Standard Test Methods for Flexible Cellular Materials - Slab, Bonded, and Molded Urethane Foams
 - .4 ASTM D5252-24, Standard Practice for the Operation of the Hexapod Tumble Drum Tester
 - .5 ASTM D5417-21, Standard Practice for Operation of the Vettermann Drum Tester
 - .6 ASTM F710-22, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
 - .7 ASTM F1869-23, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
 - .8 ASTM F2170-19a, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
- .3 California Air Resources Board (CARB):
 - .1 2007 [Suggested Control Measure \(SCM\) for Architectural Coatings](#)
- .4 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-4.129-93, Carpet for Commercial Use
- .5 Carpet and Rug Institute (CRI):
 - .1 CRI 104-2015, Standard for Installation of Commercial Carpet
 - .2 CRI 105-2015, Standard for Installation of Residential Carpet
 - .3 CRI 204-2019, Commercial Carpet Standard for Maintenance and Cleaning
 - .4 CRI 205-2019, Residential Carpet Standard for Maintenance and Cleaning
 - .5 CRI Green Label Indoor Air Quality Testing Program
 - .6 CRI Green Label Plus Indoor Air Quality Testing Program
- .6 CSA Group (CSA):
 - .1 CSA B651-18, Accessible design for the built environment
 - .2 CSA/ASC B651:23, Accessible design for the built environment

- .7 Environment and Climate Change Canada (ECCC):
 - .1 [Volatile Organic Compound \(VOC\) Concentration Limits for Architectural Coatings Regulations, \(SOR/2009-264\)](#)
 - .2 [Volatile Organic Compound Concentration Limits for Certain Products Regulations \(SOR/2021-268\)](#)
- .8 Green Seal (GS):
 - .1 GS-11-21, Paints, Coatings, Stains, and Sealers
 - .2 GS-36-13, Adhesives for Commercial Use
- .9 Health Canada (HC):
 - .1 [Textile Floor Coverings Regulations \(SOR/2016-176\)](#)
- .10 National Sanitation Foundation International (NSF):
 - .1 NSF/ANSI 140-2019, Sustainability Assessment for Carpet
- .11 South Coast Air Quality Management District (SCAQMD):
 - .1 SCAQMD Rule 1113-2016, Architectural Coatings
 - .2 SCAQMD Rule 1168-2022, Adhesive and Sealant Applications
- .12 Underwriters Laboratories Inc. (UL):
 - .1 UL 2762-11, Standard for Sustainability for Adhesives
- .13 ULC Standards (ULC):
 - .1 CAN/ULC-S102.2:2018, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by the Consultant, manufacturer's services representative, and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review installation and substrate conditions.
 - .4 Coordinate with other Subcontractors.
 - .5 Review manufacturer's instructions and warranty requirements.
- .2 Sequencing:
 - .1 Install tile carpeting after:
 - .1 areas are enclosed and weatherproofed.
 - .2 wet-work in areas is complete and dry.
 - .3 work above ceilings is complete.
 - .4 ceiling work is complete.
 - .2 Install tile carpeting before:
 - .1 demountable office partitions are installed.
 - .2 electrical and communications pedestals are installed.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Product data: Product literature and data sheets, including product characteristics, performance criteria, physical sizes, colours and patterns, example warranty documentation, and limitations.
 - .1 Submit product data for:
 - .1 each type of carpet tile
 - .2 subfloor patching compounds
 - .3 water vapour emission sealers
 - .4 primers
 - .5 adhesives
 - .6 edge and transition strips
 - .7 stair nosings
 - .8 carpet wall bases and carpet base top edge caps
 - .9 resilient wall base
 - .10 carpet protection
 - .2 Submit WHMIS SDSs for:
 - .1 primers
 - .2 adhesives
 - .3 water vapour emission sealers
- .3 Samples:
 - .1 Samples for initial selection: Representing manufacturer's [[standard] [full]] range of available colours, patterns, textures, and finishes.
 - .1 Submit samples for:
 - .1 carpet tiles, each type, pattern, and colour specified
 - .2 edge and transition strips
 - .3 stair nosings
 - .4 carpet wall bases
 - .5 carpet base top edge caps
 - .6 resilient wall base
- .4 Test and evaluation reports: Indicating carpet tile flame-spread rating and smoke developed classification acceptable to the authority having jurisdiction, and in accordance with what is specified in TILE CARPETING in this section.
- .5 Manufacturer's instructions:
 - .1 Special delivery, storage, and handling requirements.
 - .2 Installation instructions.
 - .3 Recommended sequencing.
 - .4 Cleaning procedures.
 - .5 Keep a copy on site during installation.
- .6 Site quality control submittals: Indicating results of pre-installation testing specified in EXAMINATION in this section. Describe locations of each test.
- .7 Manufacturer's reports:
 - .1 Confirming work of this section complies with manufacturer's requirements as specified in SITE QUALITY CONTROL in this section.
 - .2 Submit within 5 Working Days of site visit.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance data:
 - .1 Include, in the operation and maintenance manual, manufacturer's maintenance instructions and recommended cleaning materials and methods.

- .2 Include information on future recycling of tile carpeting, such as manufacturer's reprocessing program.

- .3 Warranty documentation: Submit manufacturer's material warranty.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Extra stock materials:
 - .1 Supply extra materials from the same production run as installed products. Package extra materials with protective covering and identify with labels.
 - .2 Supply minimum:
 - .1 5% of installed area of each type of carpet, with minimum one box.
 - .2 5% of installed carpet wall base.
 - .3 5% of used adhesive.
 - .4 5% of each type of edge and transition strips, minimum 3m lengths.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer:
 - .1 Capable of providing site service representation during construction and inspection of installation quality.
- .2 Mock-ups: Install in accordance with Section 01 43 00 - Quality Assurance.
 - .1 Install mock-ups for each specified installation pattern. Include:
 - .1 installation patterns
 - .2 installation at walls and doorways
 - .3 inside and outside corners of wall base installation
 - .4 edge and transition strip installations
 - .5 top edge caps on tile carpeting base
 - .2 Minimum size: 10 m².
 - .3 Location: On site, as directed by the Consultant.
 - .4 Acceptable mock-ups may [not] remain as part of the Work.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements, and:
 - .1 Store carpet and adhesive at a minimum 18 °C and relative humidity of a maximum 65%, for a minimum 48 hours before installation.

1.9 SITE CONDITIONS

- .1 Ambient conditions:
 - .1 Substrate: Moisture emission limits and alkalinity limits as recommended by the carpeting manufacturer.
 - .2 Temperature: Maintain minimum 18 °C ambient temperature for minimum 48 hours before, during, and minimum 48 hours after installation.
 - .3 Relative humidity: Maintain between 10% and 65% for minimum 48 hours before, during, and minimum 48 hours after installation.

- .2 Ventilation:
 - .1 Ventilate installation areas in accordance with Section 01 51 00 - Temporary Utilities. Use fans with HEPA filters.
 - .2 Run ventilation continuously for minimum 48 hours before, during, and minimum 48 hours after installation.

1.10 WARRANTY

- .1 Manufacturer warranty: Manufacturer's standard warranty document, executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights the Owner may have under the Contract.
 - .1 Manufacturer's warranty period: 15 years minimum.
 - .2 Warranty coverage:
 - .1 Excessive surface wear: More than 15% loss of pile fibre weight.
 - .2 Resiliency: More than 10% loss of backing.
 - .3 Delamination of backing.
 - .4 Edge ravel.
 - .5 Zippering.
 - .6 Exclusions: Where caster wheeled chairs are located directly over seams without chair protectors.

PART 2 PRODUCTS

2.1 TILE CARPETING

- .1 Type: []
 - .1 Style: [][As scheduled] [As indicated on [Drawings]] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].
 - .2 Pattern: [][As scheduled] [As indicated on [Drawings]] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].
 - .3 Colour: [][As scheduled] [As indicated on [Drawings]] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].
 - .4 Tile size: [[250] [450] [500] [610] mm × [450] [500] [610] [1000] mm nominal] [As scheduled] [As indicated on [Drawings]] [As selected by the [Departmental Representative] [DCC Representative] [Consultant] from manufacturer's samples].
 - .5 Provide each carpet type from same dye lot.
- .2 Face construction: [Tufted] [Needle punched] [Woven].
- .3 Pile surface appearance:
 - .1 Level loop: [Non-textured] [Textured].
 - .2 Multi-level loop: [Concealed-pile] [Sculptured].
 - .3 Cut and loop: [Plush] [Saxony].
 - .4 Cut pile: [Plain plush] [Plain saxony].
- .4 Pile fibre: To [CAN/CGSB 4.129].
 - .1 Nylon: [Bulked continuous filament (BCF)] [Staple].
 - .1 Type: [Nylon 6] [Nylon 6.6].
 - .2 Polyester: [Bulked continuous filament (BCF)] [Staple].
 - .3 Polypropylene: [Bulked continuous filament (BCF)].
- .5 Face fibre content: [].

- .6 Face fibre denier: Minimum [] g/9k.
- .7 Dyeing method: [Solution dyed] [Piece dyed] [Yarn dyed] [Stock dyed] [Printed].
- .8 Tufted carpet backing:
 - .1 Primary backing:
 - .1 Polypropylene:
 - .1 Cut pile carpet: 100% [woven] [spunbonded] polypropylene at a minimum weight of [126 g/m²].
 - .2 Loop pile carpet: 100% [woven] [spunbonded] polypropylene at a minimum weight of [109 g/m²].
 - .2 Polyester: [].
- .9 Woven carpet backing: To [CAN/CGSB 4.129] 100% moisture-resistant warp, filling, and stuffer yarns.
- .10 Secondary and unitary backings: To [CAN/CGSB 4.129].
- .11 Tile cushion backing:
 - .1 Thickness: Minimum [3] mm.
 - .2 Density: To ASTM D3574.
 - .1 Urethane: [224] kg/m³.
 - .2 Ethylene vinyl acetate (EVA) and polyvinyl chloride (PVC): [240] kg/m³.
 - .3 Compression force deflection:
 - .1 Urethane: To ASTM D3574, minimum [34.5] kPa.
 - .2 EVA and PVC: To ASTM D1667, minimum [48.3] kPa.
 - .4 Compression set at 50%: To ASTM D3574, maximum urethane [15] %.
 - .5 Compression set at 25%: To ASTM D3574, maximum EVA and PVC [10] %.
- .12 Stitches: Minimum [31.5] /10 cm.
- .13 Gauge: Minimum [39.4] /10 cm.
- .14 Pile weight density: [] g/m².
- .15 Finished pile height: Average minimum [3.5] mm.
- .16 Surface pile weight: [To ASTM D5848,] minimum [[566] [678] [813] [881] [949]] g/m².
- .17 Total weight: [].
- .18 Regulatory requirements:
 - .1 Comply with HC SOR/2016 176.
 - .2 Surface burning characteristics: To CAN/ULC S102.2.
 - .1 Flame-spread rating: Maximum [300].
 - .2 Smoke developed classification: Maximum [[300] [450] [500]].
- .19 Sustainability characteristics:
 - .1 Products [in accordance with [Section 01 47 15 - Sustainable Requirements: Construction] [Section 01 35 21 - LEED Requirements]] [certified to CRI's Green Label Indoor Air Quality Testing Program] [certified to CRI's Green Label Plus Indoor Air Quality Testing Program] [certified to NSF/ANSI 140[Silver] [Gold] [Platinum]].
 - .2 Recycled content: Minimum [75] % [post-industrial] [and] [post-consumer].
 - .3 VOC and other chemical limits: To [Section 01 35 21 - LEED Requirements] [Section 01 47 15 - Sustainable Requirements: Construction] [ECCC SOR/2024-268].

- .20 Performance/design criteria:
 - .1 Stain resistance rating (STR): Minimum Level [[6] [8]], to AATCC TM 138 test, for five washings to simulate removal of topical treatments by hot water extraction, followed by AATCC TM 175 test. Topical stain protection treatments are not acceptable.
 - .2 Soil resistance: Integral stain resistance inherent in or bonded to carpet fibre. Topical treatments are not acceptable.
 - .3 Appearance retention rating: Minimum [[3.0] [3.5]] at [12 000 cycles in accordance with ASTM D5252] [22 000 cycles, in accordance with ASTM D5417].
 - .4 Anti-microbial resistance: Permanent treatment to prevent bacteria, fungi, and bacteria growth.
 - .1 In accordance with AATCC TM 174:
 - .1 Minimum [2] mm halo of inhibition for gram positive bacteria.
 - .2 Minimum [1] mm halo of inhibition for gram negative bacteria.
 - .3 No fungal growth.
 - .5 Wear resistance: Maximum [10]% loss of pile face fibre by weight during manufacturer's warranty period.
 - .6 Resistance to delamination of secondary backing: To [ASTM D3936], minimum [1.6] kg/25 mm.
 - .7 Edge ravel: None during manufacturer's warranty period.
 - .8 Static control: Permanent static control without chemical treatment, to [AATCC TM 134] maximum [[3.0] [3.5]] kV at 20% relative humidity and 22°C for manufacturer's warranty period.
 - .9 Tuft bind: [To ASTM D1335, minimum [36] N average force] [To CAN/CGSB 4.129].
 - .10 Colourfastness:
 - .1 To light: To [AATCC TM 16.1] [AATCC TM 16.2] [AATCC TM 16.3].
 - .2 To atmospheric contaminants: To [AATCC TM 23] [AATCC TM 129].
 - .3 To crocking: To [AATCC TM 165, colour transfer minimum Class [4]].
 - .11 Dimensional stability: To ISO 2551, maximum $\pm$ [0.15]% change.

2.2 ACCESSORIES

- .1 Subfloor patching compound: Smooth trowelling, fast setting, non-shrinking, pre-mixed filler with Portland cement and polymeric modifiers, suitable for substrate conditions, and in accordance with manufacturer's instructions.
 - .1 28-day compressive strength: Minimum 20 MPa.
- .2 Water vapour emission sealer: Liquid-applied, epoxy-based, 100% solids.
 - .1 Reduces water vapour emissions through concrete slab to acceptable levels and provides a permanent barrier between concrete alkalinity and carpeting.
- .3 Primer: When recommended for site conditions, type in accordance with manufacturer's instructions for surface conditions.
- .4 Adhesives: Water-resistant type recommended by carpet and adhesive manufacturers for site conditions and application, and compatible with carpet tile backing.
 - .1 Types:
 - .1 Pressure sensitive: For releasable carpet installation.
 - .2 Factory-applied: Fully cured, pre-applied adhesive on underside of carpet tile or on self-adhesive patches applied on-site at underside of carpet tile corners.
 - .3 Multi-purpose.
- .5 Edge and transition strips: To CSA B651 for maximum vertical rise and slope.
 - .1 Aluminum: Designed for carpet tile,.
 - .1 Surface texture: Smooth.
 - .2 Widths:
 - .1 Floor flange: 38 mm.

- .2 Face: 16 mm.
 - .3 Finish: As selected by the Consultant from manufacturer's samples.
 - .6 Resilient wall base: In accordance with Section 09 65 19 - Resilient Tile Flooring.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Verify conditions comply with manufacturer's recommendations and CRI 104.
 - .2 Verify concrete substrates are cured, clean, dry, and have cured 30 days minimum.
 - .3 Verify concrete substrates are free of paint, dirt, grease, oil, curing or parting agents, and other contaminants, including sealers, that could interfere with the bonding of adhesive.
 - .4 Verify wood floor substrates are stable, firm, and do not create noises or squeaks caused by a person walking.
- .2 Pre-installation testing:
 - .1 Concrete slab testing: Perform two tests per 20 m² of floor area to determine special care required to make it suitable for carpet installation.
 - .1 Moisture vapour emission rate: To ASTM F1869.
 - .2 Relative humidity: To ASTM F2170.
 - .3 Alkalinity: To ASTM F710.

3.2 PREPARATION

- .1 Surface preparation:
 - .1 Prepare surfaces in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Comply with CRI 104.
 - .2 Fill and level cracks 3 mm wide and protrusions over 0.8 mm with appropriate and compatible subfloor patching compound.
 - .3 Comply with manufacturer's instructions for maximum patch thickness.
 - .4 Prime large patch areas with compatible primer.
 - .5 Apply water vapour emission sealer if pre-installation tests indicate moisture emission rate or alkalinity exceed carpet tile recommendations.
- .2 Demolition/removal:
 - .1 Remove existing carpet [and carpet cushion] in accordance with Section 02 42 19.48 - Carpeting Recycling.
- .3 Pre-condition tile carpeting for minimum [48] hours in accordance with manufacturer's recommendations.

3.3 INSTALLATION

- .1 Install tile carpeting in accordance with manufacturer's instructions [, reviewed shop drawings,] and CRI 104.
- .2 Install carpet tiles from same dye lot within each room/visual area.
- .3 Installation pattern: Ashlar.

- .4 Install tile carpeting with tight joints.
 - .1 Measure distance covered by eleven carpet tiles (ten joints) and confirm distance is within manufacturer's recommendations.
- .5 Fit tightly to architectural, mechanical, electrical, and communications features, furniture, and fittings.
- .6 Fit tightly to room perimeters, into recesses, and around projections.
- .7 Install tile carpeting into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- .8 Do not bridge building expansion joints with tile carpeting.
- .9 Install tile carpeting in pan type floor access covers.
- .10 Install tile carpeting with continuous, level surface without bubbles, puckers, gaps, conspicuous seams, burring, or other deficiencies.
- .11 Install edge strips at exposed carpet tile edges.
- .12 Install transition strips where tile carpeting is adjacent to other flooring materials.

3.4 WALL BASE INSTALLATION

- .1 Resilient base: In accordance with Section 09 65 19 - Resilient Tile Flooring.

3.5 SITE QUALITY CONTROL

- .1 Non-conforming work: Trapped yarn between carpet tiles is not acceptable.
- .2 Manufacturer services: Provide manufacturer's site services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .1 Schedule site visits to review work of this section:
 - .1 After delivery and storage of products, and when preparatory work is complete, but before installation begins;
 - .2 during pre-installation substrate testing;
 - .3 during mock-up construction;
 - .4 during surface preparation;
 - .5 during progress of work at approximately 30% and 60% completion; and
 - .6 upon completion of the work of this section and cleaning.

3.6 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning, and:
 - .1 Clean excess adhesive off tile carpeting promptly after installation using methods and materials recommended by carpet tile and adhesive manufacturers.
 - .2 Vacuum carpets immediately after completion of installation in accordance with CRI 204.
 - .3 Replace carpet tiles that cannot be cleaned to the acceptance of the Consultant.
- .2 Waste management:
 - .1 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal.

3.7 PROTECTION

- .1 Protect partially installed and completed work from damage in accordance with Section 01 76 00 - Protecting Installed Construction, and:
 - .1 Prohibit traffic on installed carpet for minimum 48 hours or longer if recommended by carpet manufacturer, and until adhesive is completely cured.
 - .2 Temporarily protect carpet with manufacturer's recommended material.

END OF SECTION

PART 1 GENERAL

1.1 DEFINITIONS

- .1 Application Specialist: An individual who performs surface preparation and application of protective coatings and linings to steel and concrete surfaces of complex industrial structures.

1.2 REFERENCE STANDARDS

- .1 Environmental Protection Agency (EPA)
 - .1 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, EPA Method 24 - Surface Coatings.
 - .2 SW-846, Test Method for Evaluating Solid Waste, Physical/Chemical Methods.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .3 Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual-[current edition].
 - .2 Standard GPS-1-12, MPI Green Performance Standard.
 - .3 Standard GPS-2-12, MPI Green Performance Standard.
- .4 National Research Council Canada (NRC)
 - .1 National Fire Code of Canada 2015 (NFC).
- .5 Society for Protective Coatings (SSPC)
 - .1 Systems and Specifications, SSPC Painting Manual 2011.
- .6 NACE International
 - .1 ANSI/NACE No. 13/SSPC-ACS-1-2016 -SG, Industrial Coating and Lining Application Specialist Qualification and Certification

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling
 - .1 Provide work schedule for various stages of painting to Consultant for approval. Provide schedule minimum of 48 hours in advance of proposed operations.
 - .2 Obtain written authorization from Consultant for changes in work schedule.
 - .3 Schedule new additions to existing building coordinate painting operations with other trades.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's instructions, printed product literature and data sheets for paint and paint products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 29 - Health, Safety, and Emergency Response Procedures.
 - .3 Confirm products to be used are in MPI's approved product list.

- .4 Upon completion, provide records of products used. List products in relation to finish system and include the following:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers.
 - .4 MPI Environmentally Friendly classification system rating.
 - .5 Manufacturer's Safety Data Sheets (SDS).
- .3 Samples:
 - .1 Provide 200 x 300 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:
 - .1 3 mm[plate steel for finishes over metal surfaces.
 - .2 When approved, samples shall become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.
 - .3 Provide full range of available colours where colour availability is restricted.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Provide project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Provide calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Provide listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Low-Emitting Materials:
 - .1 Provide listing of adhesives and sealants and paints and coatings used in building, showing compliance with VOC and chemical component limits or restriction requirements.
- .5 Certificates:
 - .1 Submit certifications for Application Specialists to demonstrate compliance to the requirements of ANSI/NACE No.13.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Provide operation and maintenance data for [painting materials] for incorporation into manual.
- .3 Include:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers.
 - .4 MPI Environmentally Friendly classification system rating.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Submit 1 four litre can of each type and colour of primer and finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Contractor: to have a minimum of 5 years proven satisfactory experience. When requested, provide list of last 3 comparable jobs including, job name and location, specifying authority, and project manager.
 - .2 Qualified journeypersons as defined by local jurisdiction to be engaged in painting work
 - .3 Apprentices: may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.
 - .4 Conform to latest MPI requirements for exterior painting work including preparation and priming.
 - .5 Materials: in accordance with MPI Painting Specification Manual "Approved Product" listing and from a single manufacturer for each system used.
 - .6 Retain purchase orders, invoices and documents to prove conformance with noted MPI requirements when requested by Consultant.
 - .7 Standard of Acceptance:
 - .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
 - .2 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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.
 - .1 Labels: to indicate:
 - .1 Type of paint or coating.
 - .2 Compliance with applicable standard.
 - .3 Colour number in accordance with established colour schedule.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Observe manufacturer's recommendations for storage and handling.
 - .3 Store materials and supplies away from heat generating devices.
 - .4 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.
 - .5 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Consultant. After completion of operations, return areas to clean condition to approval of Consultant.
 - .6 Remove paint materials from storage only in quantities required for same day use.
 - .7 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.
 - .8 Fire Safety Requirements:
 - .1 Provide one 9 kg Type ABC fire extinguisher adjacent to storage area.

- .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
- .3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada (NFC).
- .9 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

1.9 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces.
 - .2 Do not perform painting work unless adequate and continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.
 - .3 Where required, provide continuous ventilation for seven days after completion of application of paint.
 - .4 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
 - .5 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities to be provided by General Contractor.
 - .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Unless specifically pre-approved by specifying body, Paint Inspection Agency and, applied product manufacturer, perform no painting work when:
 - .1 Ambient air and substrate temperatures are below 10 degrees C.
 - .2 Substrate temperature is over 32 degrees C unless paint is specifically formulated for application at high temperatures.
 - .3 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.
 - .4 Relative humidity is above 85% or when dew point is less than 3 degrees C variance between air/surface temperature.
 - .5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.
 - .2 Perform no painting work when maximum moisture content of substrate exceeds:
 - .1 12% for concrete and masonry (clay and concrete brick/block).
 - .3 Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".
 - .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Application Requirements:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits noted herein.
 - .3 Apply paint when previous coat of paint is dry or adequately cured.
 - .4 Apply paint finishes when conditions forecast for entire period of application fall within manufacturer's recommendations.

- .5 Do not apply paint when:
 - .1 Temperature is expected to drop below 10 degrees C before paint has thoroughly cured.
 - .2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's limits.
 - .3 Surface to be painted is wet, damp or frosted.
- .6 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.
- .7 Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.
- .8 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Only paint materials listed in latest edition of MPI Approved Products List (APL) are acceptable for use on this project
- .2 Paint materials for paint systems: to be products of single manufacturer.
- .3 Use only MPI listed L rated materials.
- .4 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, to be as follows:
 - .1 Be water-based.
 - .2 Be non-flammable.
 - .3 Be manufactured without compounds which contribute to ozone depletion in upper atmosphere.
 - .4 Be manufactured without compounds which contribute to smog in the lower atmosphere.
 - .5 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.
- .5 Water-borne surface coatings must be manufactured and transported in a manner that steps of processes, including disposal of waste products arising there from, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada, Fisheries Act and Canadian Environmental Protection Act (CEPA).
- .6 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .7 Water-borne surface coatings and recycled water-borne surface coatings must have flash point of 61.0 degrees C or greater.
- .8 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:
 - .1 Matter in undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
 - .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.

- .9 Recycled water-borne surface coatings must contain 50% post-consumer material by volume.
- .10 Recycled water-borne surface coatings must not contain:
 - .1 Lead in excess of 600.0 ppm weight/weight total solids.
 - .2 Mercury in excess of 50.0 ppm weight/weight total product.
 - .3 Cadmium in excess of 1.0 ppm weight/weight total product.
 - .4 Hexavalent chromium in excess of 3.0 ppm weight/weight total product.
 - .5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.
- .11 The following must be performed on each batch of consolidated post-consumer material before surface coating is reformulated and canned. These tests must be performed at a laboratory or facility which has been accredited by the Standards Council of Canada.
 - .1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846
 - .2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846
 - .3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846

2.2 COLOURS

- .1 Consultant will provide Colour Schedule after Contract award.
- .2 Colour schedule will be based upon selection of 5 base colours and 3 accent colours. No more than 8 colours will be selected for entire project and no more than 3 colours will be selected in each area.
- .3 Selection of colours will be from manufacturers' full range of colours.
- .4 Where specific products are available in restricted range of colours, selection will be based on limited range.
- .5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats if requested by Consultant.
- .6 For deep and ultra deep colours 4 coats may be required.

2.3 MIXING AND TINTING

- .1 Perform colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials is allowed only with Consultant's written permission.
- .2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.
- .3 Add thinner to paint manufacturer's recommendations. Do not use kerosene or organic solvents to thin water-based paints.
- .4 Thin paint for spraying according in accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Consultant.
- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.
- .6 Deep and ultra deep colors; 4 coats may be required.

2.4 GLOSS/SHEEN RATINGS

- .1 Paint gloss: defined as sheen rating of applied paint, in accordance with following values:

Gloss Level Category	Units @ 60 Degrees	Units @ 85 Degrees
G1 - matte finish	0 to 5	max. 10
G2 - velvet finish	0 to 10	10 to 35
G3 - eggshell finish	10 to 25	10 to 35
G4 - satin finish	20 to 35	min. 35
G5 - semi-gloss finish	35 to 70	
G6 - gloss finish	70 to 85	
G7 - high gloss finish	> 85	

- .2 Gloss level ratings of painted surfaces as specified.

2.5 EXTERIOR PAINTING SYSTEMS

- .1 Galvanized Metal: not chromate passivated
- .1 EXT 5.3A - Latex [insert gloss level] (over cementitious primer) finish.
 - .2 EXT 5.3B - Alkyd [insert gloss level] (over cementitious primer) finish.
 - .3 EXT 5.3C - Epoxy finish [gloss] [semi-gloss] (over epoxy primer) [high contact/traffic areas].
 - .4 EXT 5.3D - Polyurethane, Pigmented finish (over vinyl wash and epoxy primer) [high contact/traffic areas].
 - .5 EXT 5.3E - Bituminous finish [low contact/traffic areas].
 - .6 EXT 5.3F - Aluminum paint finish (over cementitious primer) [low contact/traffic areas].
 - .7 EXT 5.3G - W.B. light industrial [insert gloss level] (over cementitious primer) coating.
 - .8 EXT 5.3H - Latex [insert gloss level] finish (over W.B. primer) [low contact/traffic areas].
 - .9 EXT 5.3J - W.B. light industrial [insert gloss level] coating (over w.b. primer) [for moderate chemical resistance].
 - .10 EXT 5.3K - W.B. light industrial [insert gloss level] coating (over epoxy primer).
 - .11 EXT 5.3L - Polyurethane, Pigmented (over epoxy primer) [high contact/traffic].

2.6 SOURCE QUALITY CONTROL

- .1 Perform following tests on each batch of consolidated post-consumer material before surface coating is reformulated and canned. Testing by laboratory or facility which has been accredited by Standards Council of Canada.
- .1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846
 - .2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846

- .3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 GENERAL

- .1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable to be painted in accordance with manufacturer's written instructions:
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.
- .2 Exterior repainting work: inspected by MPI Accredited Paint Inspection Agency (inspector) acceptable to specifying authority and local Painting Contractor's Association. Painting contractor to notify Paint Inspection Agency minimum of one week prior to commencement of work and provide copy of project repainting specification and Finish Schedule.
- .3 Exterior surfaces requiring repainting: inspected by both painting contractor and Paint Inspection Agency who will notify Consultant in writing of defects or problems, prior to commencing repainting work, or after surface preparation if unseen substrate damage is discovered.
- .4 Where assessed degree of surface degradation of DSD-1 to DSD-3 before preparation of surfaces for repainting is revealed to be DSD-4 after preparation, repair or replacement of such unforeseen defects discovered are to be corrected, as mutually agreed, before repainting is started.
- .5 Where "special" repainting or recoating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer to provide as part of work, certification of surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to [Departmental Representative] [DCC Representative] [Consultant].

3.4 PREPARATION

- .1 Perform preparation and operations for exterior painting in accordance with MPI Maintenance Repainting Manual except where specified otherwise
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.

- .3 Clean and prepare exterior surfaces to be repainted in accordance with MPI Maintenance Repainting Manual requirements. Refer to the MPI Manual in regard to specific requirements and as follows:
 - .1 Remove dust, dirt, and surface debris by vacuuming, wiping with dry, clean cloths or compressed air.
 - .2 Wash surfaces with a biodegradable detergent [and bleach where applicable] and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
 - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
 - .4 Allow surfaces to drain completely and allow to dry thoroughly. Allow sufficient drying time and test surfaces using electronic moisture meter before commencing work.
 - .5 Use water-based cleaners in place of organic solvents where surfaces will be repainted using water based paints.
 - .6 Many water-based paints cannot be removed with water once dried. Minimize use of kerosene or such organic solvents to clean up water-based paints.
- .4 Clean metal surfaces to be repainted by removing rust, dirt, oil, grease and foreign substances in accordance with MPI requirements. Remove such contaminants from surfaces, pockets and corners to be repainted by brushing with clean brushes, blowing with clean dry compressed air, or brushing/vacuum cleaning as required.
- .5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before priming and between applications of remaining coats. Touch-up, spot prime, and apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .6 Do not apply paint until prepared surfaces have been accepted by Consultant.
- .7 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

3.5 PROTECTION

- .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by Consultant.
- .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
- .3 Protect factory finished products and equipment.
- .4 Protect passing pedestrians, and general public in and about building.
- .5 Remove light fixtures, surface hardware on doors, and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Store items and re-install after painting is completed.
- .6 Move and cover exterior furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
- .7 As painting operations progress, place "WET PAINT" signs in pedestrian and vehicle traffic areas to approval of Consultant]

3.6 APPLICATION

- .1 Method of application to be as approved by Consultant. Apply paint by brush, roller or airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.

- .2 Brush and Roller Application:
 - .1 Apply paint in a uniform layer using brush and/or roller of types suitable for application.
 - .2 Work paint into cracks, crevices and corners.
 - .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
 - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces to be free of roller tracking and heavy stipple unless approved by Consultant.
 - .5 Remove runs, sags and brush marks from finished work and repaint.
- .3 Spray Application:
 - .1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
 - .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
 - .3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.
 - .4 Brush out immediately runs and sags.
 - .5 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray.
 - .6 Wood, stucco, concrete, cement masonry units CMU's and brick; if sprayed, must be back rolled.
- .4 Use dipping, sheepskins or daubers when no other method is practical in places of difficult access and when specifically authorized Consultant.
- .5 Apply coats of paint as continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .7 Sand and dust between coats to remove visible defects.
- .8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as projecting ledges.
- .9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.7 MECHANICAL/ELECTRICAL EQUIPMENT

- .1 Unless otherwise specified, paint exterior exposed conduits, piping, hangers, duct work and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as noted otherwise.
 - .2 Do not paint over nameplates.
 - .3 Paint fire protection piping red.
 - .4 Paint natural gas piping yellow.
 - .5 Paint steel electrical light standards. Do not paint outdoor transformers and substation equipment.
-

3.8 SITE QUALITY CONTROL

- .1 Exterior painting and decorating work to be inspected by MPI Accredited Paint Inspection Agency (inspector) acceptable to specifying authority and local Painting Contractor's Association. Painting contractor will notify Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of project painting specification, plans and elevation drawings (including pertinent details) as well as Finish Schedule.
- .2 Exterior surfaces requiring painting to be inspected by Paint Inspection Agency who will notify Consultant and General Contractor in writing of defects or problems, prior to commencing painting work, or after prime coat shows defects in substrate.
- .3 Where "special" painting, coating or decorating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer to provide as part of this work, certification of surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to Consultant.
- .4 Standard of Acceptance:
 - .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
 - .2 Ceilings: no defects visible from floor at 45 degrees degrees to surface when viewed using final lighting source.
 - .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.
- .5 Field inspection of painting operations to be carried out by independent inspection firm as designated by Consultant.
- .6 Advise Consultant when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.
- .7 Cooperate with inspection firm and provide access to areas of work.
- .8 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Consultant.

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning:
 - .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 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.10 RESTORATION

- .1 Clean and re-install hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

- .4 Protect freshly completed surfaces from paint droppings and dust to approval of Consultant. Avoid scuffing newly applied paint.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Consultant.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 Environmental Protection Agency (EPA)
 - .1 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, EPA Method 24 - Surface Coatings.
 - .2 SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .3 Master Painters Institute (MPI)
 - .1 The Master Painters Institute (MPI)/Architectural Painting Specification Manual (ASM)-[current edition].
 - .2 Standard GPS-1-12, MPI Green Performance Standard.
 - .3 Standard GPS-2-12, MPI Green Performance Standard.
- .4 National Research Council Canada (NRC)
 - .1 National Fire Code of Canada [2015] (NFC).
- .5 Society for Protective Coatings (SSPC)
 - .1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling:
 - .1 Submit work schedule for various stages of painting to Consultant for review. Provide schedule minimum of 48 hours in advance of proposed operations.
 - .2 Obtain written authorization from Consultant for changes in work schedule.
 - .3 Schedule new additions to existing building coordinate painting operations with other trades.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's instructions, printed product literature and data sheets for [paint and paint products] and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit copy of WHMIS SDS in accordance with Section 01 35 29 - Health, Safety, and Emergency Response Procedures.
 - .3 Confirm products to be used are in MPI's approved product list.
- .3 Upon completion, provide records of products used. List products in relation to finish system and include the following:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers.
 - .4 MPI Environmentally Friendly classification system rating.
 - .5 Manufacturer's Safety Data Sheets (SDS).
 - .6 MPI #.

- .4 Samples:
 - .1 Submit full range colour sample chips to indicate where colour availability is restricted.
 - .2 Submit [duplicate] [200 x 300] mm sample panels of each [paint] [stain] [clear coating] [special finish] with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:
 - .1 3 mm plate steel for finishes over metal surfaces.
 - .2 50 mm concrete block for finishes over concrete or concrete masonry surfaces.
 - .3 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.
 - .3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
- .5 Test reports: Provide certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .1 Lead, cadmium and chromium: presence of and amounts.
 - .2 Mercury: presence of and amounts.
 - .3 Organochlorines and PCBs: presence of and amounts.
- .6 Certificates: Provide certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties. MPI Gateway #.
- .7 Manufacturer's Instructions:
 - .1 Provide manufacturer's installation and application instructions.
- .8 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Provide project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Provide calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of [post-consumer] [and] [post-industrial] content, and total cost of materials for project.
 - .3 Low-Emitting Materials:
 - .1 Provide listing of adhesives and sealants and paints and coatings used in building, showing compliance with VOC and chemical component limits or restriction requirements.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Provide operation and maintenance data for painting materials for incorporation into manual.
- .3 Include:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers.
 - .4 MPI Environmentally Friendly classification system rating.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Submit 1 four litre can of each type and colour of primer and finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Contractor: to have a minimum of 5 years proven satisfactory experience. When requested, provide list of last 3 comparable jobs including, job name and location, specifying authority, and project manager.
 - .2 Qualified journeypersons as defined by local jurisdiction to be engaged in painting work.
 - .3 Apprentices: may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.
 - .4 Conform to latest MPI requirements for exterior painting work including preparation and priming.
 - .5 Materials: in accordance with MPI Painting Specification Manual "Approved Product" listing and from a single manufacturer for each system used.
 - .6 Retain purchase orders, invoices and documents to prove conformance with noted MPI requirements when requested by Consultant.
 - .7 Standard of Acceptance:
 - .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
 - .2 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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.
 - .1 Labels: to indicate:
 - .1 Type of paint or coating.
 - .2 Compliance with applicable standard.
 - .3 Colour number in accordance with established colour schedule.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Observe manufacturer's recommendations for storage and handling.
 - .3 Store materials and supplies away from heat generating devices.
 - .4 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.
 - .5 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Consultant. After completion of operations, return areas to clean condition to approval of Consultant.
 - .6 Remove paint materials from storage only in quantities required for same day use.
 - .7 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.
 - .8 Fire Safety Requirements:
 - .1 Provide one 9kg Type ABC fire extinguisher adjacent to storage area.

- .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
- .3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada (NFC).
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

1.8 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces.
 - .2 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.
 - .3 Provide continuous ventilation for 7 days after completion of application of paint.
 - .4 Coordinate use of existing ventilation system with Consultant and ensure its operation during and after application of paint as required.
 - .5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
 - .6 Provide minimum lighting level of 323 Lux on surfaces to be painted.
 - .7 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Unless pre-approved written approval by Paint Inspection Agency Authority and product manufacturer, perform no painting when:
 - .1 Ambient air and substrate temperatures are below 10 degrees C.
 - .2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.
 - .3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.
 - .4 The relative humidity is under 85% or when the dew point is more than 3 degrees C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.
 - .5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.
 - .6 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.
 - .2 Perform painting work when maximum moisture content of the substrate is below:
 - .1 12% for concrete and masonry (clay and concrete brick/block). Allow new concrete and masonry to cure minimum of 28 days.
 - .2 12% for plaster and gypsum board.
 - .3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".
 - .4 Test concrete, masonry and plaster surfaces for alkalinity as required.

- .8 Surface and Environmental Conditions:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
 - .3 Apply paint when previous coat of paint is dry or adequately cured.
- .9 Additional interior application requirements:
 - .1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.
 - .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Consultant such that painted surfaces will have dried and cured sufficiently before occupants are affected.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Only Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project
- .2 Provide paint materials for paint systems from single manufacturer.
- .3 Conform to latest MPI requirements for interior painting work including preparation and priming
- .4 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids to be:
 - .1 Be Water-based.
 - .2 Be non-flammable.
 - .3 Be manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
 - .4 Be manufactured without compounds which contribute to smog in the lower atmosphere.
 - .5 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.
- .5 Ensure manufacture and process of both water-borne surface coatings and recycled water-borne surface coatings does not release:
 - .1 Matter in undiluted production plant effluent generating 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to natural watercourse or sewage treatment facility lacking secondary treatment.
 - .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to natural watercourse or a sewage treatment facility lacking secondary treatment.
- .6 Recycled water-borne surface coatings to contain 50% post-consumer material by volume.
- .7 Recycled water-borne surface coatings must not contain:
 - .1 Lead in excess of 600.0 ppm weight/weight total solids.
 - .2 Mercury in excess of 50.0 ppm weight/weight total product.
 - .3 Cadmium in excess of 1.0 ppm weight/weight total product.
 - .4 Hexavalent chromium in excess of 3.0 ppm weight/weight total product.
 - .5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

2.2 COLOURS

- .1 Consultant will provide Colour Schedule after Contract award.
- .2 Colour schedule will be based upon selection of 5 base colours and 3 accent colours. No more than 8 colours will be selected for entire project and no more than 3 colours will be selected in each area.
- .3 Selection of colours will be from manufacturers full range of colours.
- .4 Where specific products are available in restricted range of colours, selection based on limited range.
- .5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats, if requested by Consultant.
- .6 For deep and ultra deep colours; 4 coats may be required.

2.3 MIXING AND TINTING

- .1 Perform colour tinting operations prior to delivery of paint to site. Obtain written approval from Consultant for tinting of painting materials.
- .2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.
- .3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
- .4 Thin paint for spraying in accordance with paint manufacturer's instructions.
- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity. Strain as necessary.

2.4 GLOSS/SHEEN RATINGS

- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish (flat)	Max. 5	Max. 10
Gloss Level 2 - Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35
Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

- .2 Gloss level ratings of painted surfaces as indicated.

2.5 INTERIOR PAINTING SYSTEMS

- .1 Concrete masonry units: smooth and split face block and brick:
- .1 INT 4.2A - Latex [insert gloss level] (over latex block filler) finish.
 - .2 INT 4.2B - Latex [insert gloss level]/[insert texture type] (flat and non-flat) aggregate coating.
 - .3 INT 4.2C - Alkyd [insert gloss level] (over latex block filler) finish.
 - .4 INT 4.2D - High performance architectural latex (over latex block filler) [insert gloss level] finish.
 - .5 INT 4.2E - Institutional low odour/ VOC [insert gloss level] (over latex block filler) finish.
 - .6 INT 4.2F - Epoxy (tile-like) finish [gloss] [semi-gloss] (over latex block filler) [for dry environments].
 - .7 INT 4.2G - Epoxy (tile-like) finish [gloss] [semi-gloss] (over latex block filler) [for wet environments].
 - .8 INT 4.2H - Multicolour (over latex block filler) finish.
 - .9 INT 4.2J - Epoxy-Modified Latex finish (over latex block filler) [for dry environments].
 - .10 INT 4.2K - W.B. light industrial [insert gloss level] (over latex block filler) coating.
 - .11 INT 4.2L - Water repellent (non-paintable) finish (not for low density block).
 - .12 INT 4.2M Water repellent (paintable) finish (not for low density block).
 - .13 INT 4.2N - Alkyd [insert gloss level] finish (over latex block filler and primer sealer).
 - .14 INT 4.2P - High Performance Architectural Latex [Insert gloss level] (over alkali-resistant primer).
 - .15 INT 4.2R - Epoxy High Build [gloss] [low gloss] (over epoxy block filler)
- .2 Structural steel and metal fabrications: columns, beams, joists:
- .1 INT 5.1A - Quick dry enamel [gloss] [semi-gloss] (over Q.D. alkyd primer) finish.
 - .2 INT 5.1B - W.B. light industrial [insert gloss level] (over W.B. rust-inhibitive primer) coating.
 - .3 INT 5.1C - W.B. Dry Fall [Insert gloss level] (over Q.D. alkyd primer) finish.
 - .4 INT 5.1CC - W.B. Dry Fall [Insert gloss level] (over alkyd primer) finish.
 - .5 INT 5.1D - Alkyd dry fall [Insert gloss level] (over Q.D. alkyd primer) finish.
 - .6 INT 5.1DD - Alkyd dry Fall [Insert gloss level] (over alkyd primer) finish.
 - .7 INT 5.1E Alkyd - [insert gloss level] (over Q.D. alkyd primer) finish.
 - .8 INT 5.1EE Alkyd - [insert gloss level] (over alkyd primer) finish.
 - .9 INT 5.1F - Polyurethane, Pigmented finish (over epoxy primer).
 - .10 INT 5.1G - Polyurethane, Pigmented finish (over high-build epoxy).
 - .11 INT 5.1H - Polyurethane, Pigmented finish (over epoxy and inorganic zinc).
 - .12 INT 5.1J - Polyurethane, Pigmented finish (over epoxy and epoxy zinc rich primer).
 - .13 INT 5.1K - Epoxy-Modified Latex (over W.B. rust-inhibitive primer) finish.
 - .14 INT 5.1L - Epoxy [gloss] [semi-gloss] (over epoxy primer) finish.
 - .15 INT 5.1LL - Epoxy Deck coating (over epoxy primer) finish.
 - .16 INT 5.1M - Aluminum paint [insert gloss level] (over Q.D alkyd primer) finish.
 - .17 INT 5.1MM - Aluminum paint [insert gloss level] (over alkyd primer) finish.
 - .18 INT 5.1N - W.B. light industrial [insert gloss level] coating (over epoxy primer).
 - .19 INT 5.1P - High build epoxy (over epoxy zinc rich primer and high build epoxy).
 - .20 INT 5.1Q - Latex [insert gloss level] finish (over Q.D. alkyd primer).
 - .21 INT 5.1QQ - Latex [insert gloss level] finish (over alkyd primer).
 - .22 INT 5.1R - High performance architectural latex [insert gloss level] (over Q.D. alkyd primer) finish.
 - .23 INT 5.1RR - High performance architectural latex [insert gloss level] (over alkyd primer) finish.
 - .24 INT 5.1S - Institutional low odour/ VOC [insert gloss level] (over W.B. rust-inhibitive primer) finish.
 - .25 INT 5.1T - Alkyd [insert gloss level] finish (over surface tolerant primer).
 - .26 INT 5.1TT - Alkyd, W.B. [insert gloss level] finish (over W.B. rust-inhibitive primer).
 - .27 INT 5.1U - Polyurethane, Pigmented finish (over H.B. self-priming epoxy).

- .28 INT 5.1V - Epoxy finish [gloss] [semi-gloss] (over H.B. self-priming epoxy).
- .29 INT 5.1W - Alkyd [insert gloss level] finish (over Q.D. shop primer) [for dry locations only].
- .30 INT 5.1X - Latex [insert gloss level] finish (over Q.D. shop primer) [for dry locations only].
- .31 INT 5.1Y - Epoxy High Build [gloss] [low-gloss] (over epoxy primer) with SRA.
- .32 INT 5.1Z - W.B. Dry fall (over Q.D. shop primer) (for dry locations).
- .33 INT 5.1ZZ - Alkyd Dry Fall (over Q.D. shop primer) (for dry locations).
- .34 INT 5.1Z - Q.D. Shop paint finish (for dry locations only) [do not topcoat].

.3 Galvanized metal: doors, frames, railings, misc. steel, pipes, overhead decking, and ducts.

- .1 INT 5.3A - Latex [insert gloss level] (over cementitious primer) finish.
- .2 INT 5.3B - W.B. light industrial [insert gloss level] (over cementitious primer) coating.
- .3 INT 5.3C - Alkyd [insert gloss level] finish (over cementitious primer).
- .4 INT 5.3D - Epoxy finish [gloss] [semi-gloss] (over epoxy primer).
- .5 INT 5.3F - Alkyd dry wall finish [insert gloss level] (low contact/low traffic) (over cementitious primer).
- .6 INT 5.3G - Aluminum paint (over cementitious primer) finish.
- .7 INT 5.3H - W.B. dry fall [insert gloss level] finish (low contact/low traffic).
- .8 INT 5.3J - Latex [insert gloss level] finish (over W.B. galvanized primer).
- .9 INT 5.3K - W.B. light industrial [insert gloss level] coating (over W.B. galvanized primer).
- .10 INT 5.3L - Alkyd [insert gloss level] finish (over non-cementitious primer).
- .11 INT 5.3M - High performance architectural latex [insert gloss level] (over W.B. galvanized primer) finish.
- .12 INT 5.3N - Institutional low odour/ VOC [insert gloss level] (over W.B. galvanized primer) finish.

.4 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:

- .1 INT 9.2A - Latex [insert gloss level] finish (over latex primer/sealer).
- .2 INT 9.2B - High performance architectural latex [insert gloss level] (over latex primer/sealer) finish.
- .3 INT 9.2C - Alkyd [insert gloss level] finish (over latex primer/sealer).
- .4 INT 9.2CC - Alkyd, W.B. [insert gloss level] finish.
- .5 INT 9.2E - Epoxy (tile-like) [gloss] [semi-gloss] (over latex primer/sealer) finish.
- .6 INT 9.2F - Epoxy-Modified Latex (tile-like) [gloss] [semi-gloss] (over latex primer/sealer) finish.
- .7 INT 9.2G - Multicolour (over primer sealer for multi-color systems) finish.
- .8 INT 9.2H - Fire Retardant, Clear coating (ULC rated)
- .9 INT 9.2HH - Fire Retardant, Pigmented coating (ULC rated)
- .10 INT 9.2J - W.B. Fire Retardant coating (ULC rated)
- .11 INT 9.2K - Latex [insert gloss level] finish (over alkyd primer /sealer) [for plaster only].
- .12 INT 9.2L - W.B. light industrial [insert gloss level] (over latex primer/sealer) coating.
- .13 INT 9.2M - Institutional low odour VOC [insert gloss level] (over primer sealer, low odour low VOC) finish.
- .14 Epoxy High Build [gloss] [low gloss] (over latex sealer).

2.6 SOURCE QUALITY CONTROL

- .1 Perform following tests on each batch of consolidated post-consumer material before surface coating is reformulated and canned. Testing by laboratory or facility which has been accredited by Standards Council of Canada.
 - .1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846
 - .2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846
 - .3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 GENERAL

- .1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable to be painted in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Consultant.
- .2 Interior repainting work: inspected by MPI Accredited Paint Inspection Agency (inspector) acceptable to specifying authority and local Painting Contractor's Association. Painting contractor to notify Paint Inspection Agency minimum of [one] week prior to commencement of work and provide copy of project repainting specification and Finish Schedule.
- .3 Interior surfaces requiring repainting: inspected by both painting contractor and Paint Inspection Agency who will notify Consultant in writing of defects or problems, prior to commencing repainting work, or after surface preparation if unseen substrate damage is discovered.
- .4 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- .5 Maximum moisture content as follows:
 - .1 Stucco, plaster and gypsum board: 12%.
 - .2 Concrete: 12%.
 - .3 Clay and Concrete Block/Brick: 12%.

3.4 PREPARATION

- .1 Protection (not applicable to new painting work):
 - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Consultant.
 - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
 - .3 Protect factory finished products and equipment.
 - .4 Protect passing pedestrians, and general public in and about the building.
- .2 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
 - .1 Remove dust, dirt, and other surface debris by [vacuuming,] wiping with dry, clean cloths [or compressed air].

- .2 Wash surfaces with a biodegradable detergent [and bleach where applicable] and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
- .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
- .4 Allow surfaces to drain completely and allow to dry thoroughly.
- .5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
- .6 Use trigger operated spray nozzles for water hoses.
- .7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.
- .3 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .4 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
 - .1 Apply sealer to MPI #36 over knots, pitch, sap and resinous areas
 - .2 Apply wood filler to nail holes and cracks.
 - .3 Tint filler to match stains for stained woodwork.
- .5 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- .6 Carried out during shop priming: clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by blowing with clean dry compressed air or vacuum cleaning.
- .7 Touch up of shop primers with primer as specified.
- .8 Do not apply paint until prepared surfaces have been accepted by Consultant

3.5 APPLICATION

- .1 Method of application to be as approved by Consultant. Apply paint by brush, roller or airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.
- .2 Brush and Roller Application:
 - .1 Apply paint in uniform layer using brush and/or roller type suitable for application.
 - .2 Work paint into cracks, crevices and corners.
 - .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
 - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
 - .5 Remove runs, sags and brush marks from finished work and repaint.
- .3 Spray application:
 - .1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
 - .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
 - .3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.
 - .4 Brush out immediately all runs and sags.

- .5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.
- .4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.
- .5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .7 Sand and dust between coats to remove visible defects.
- .8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .9 Finish closets and alcoves as specified for adjoining rooms.
- .10 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
- .11 Wood, drywall, plaster, stucco, concrete, concrete masonry units and brick; if sprayed, must be back rolled.

3.6 MECHANICAL/ELECTRICAL EQUIPMENT

- .1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.
- .2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
- .3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .4 Do not paint over nameplates.
- .5 Keep sprinkler heads free of paint.
- .6 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- .7 Paint fire protection piping red.
- .8 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .9 Paint natural gas piping yellow.
- .10 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- .11 Do not paint interior transformers and substation equipment.

3.7 SITE TOLERANCES

- .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
- .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
- .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.8 SITE QUALITY CONTROL

- .1 Interior painting and decorating work to be inspected by a MPI Accredited Paint Inspection Agency (inspector) acceptable to specifying authority and local Painting Contractor's Association. Painting contractor will notify Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of project painting specification, plans and elevation drawings (including pertinent details) as well as a Finish Schedule.
- .2 Interior surfaces requiring painting to be inspected by Paint Inspection Agency who will notify Consultant and General Contractor in writing of defects or problems, prior to commencing painting work, or after prime coat shows defects in substrate.
- .3 Field inspection of painting operations to be carried out by independent inspection firm as designated by Consultant.
- .4 Advise Consultant when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.
- .5 Cooperate with inspection firm and provide access to areas of work.
- .6 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Consultant.

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .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 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.10 RESTORATION

- .1 Clean and re-install hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect freshly completed surfaces from paint droppings and dust to approval of Consultant. Avoid scuffing newly applied paint.

- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Consultant.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions and Elements
 - .2 ASTM E336-14, Standard Method for Measurement of Airborne Sound Insulation in Buildings
- .2 ULC Standards (ULC):
 - .1 CAN/ULC-S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for operable partitions and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate head and jamb details, opening sizes, anchorage clearances, hardware, finish pattern and colour.
- .4 Samples:
 - .1 Submit duplicate 300 x 200 mm samples of vinyl fabric covering for each selected folding partition cover.
- .5 Sustainable Design Submittals:
 - .1 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of [post-consumer] [and] [post-industrial] content, and total cost of materials for project.
 - .2 Regional Materials: submit evidence that project incorporates required percentage 10% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
 - .3 Low-Emitting Materials:
 - .1 Submit listing of adhesives and sealants and paints and coatings used in building, showing compliance with VOC and chemical component limits or restriction requirements.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for operable partitions for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Certifications:
 - .1 Test reports: submit certified test reports for sound transmission and fire hazard classification from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect specified materials from nicks, scratches, and blemishes.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MANUFACTURER

- .1 This specification is based on Moveable Partitions 5500 Series as manufactured by Corflex.

2.2 DESIGN REQUIREMENTS

- .1 Design and fabricate accordion folding partitions with minimum STC of 52 tested to ASTM E90
- .2 Use vinyl fabric for covering with maximum:
 - .1 Flame spread - 25.
 - .2 Fuel contributed - 35.
 - .3 Smoke developed - 50; when tested to CAN/ULC-S102.2

2.3 MATERIALS

- .1 Panels:
 - .1 Panels will be nominally 92mm (3 5/8") thick in manufacturer's standard widths. Panel faces must be removable and replaceable on site. Channels made of 1.3mm (18 gauge) steel will be installed horizontally inside every panel and spaced at 610mm to 762mm (24" to 36") c/c. Channel dimensions will be 51mm X 51mm (2" X 2") and will insure a higher impact and torsional capacity. Panel faces must be removable and replaceable on site.
- .2 Frames shall fully enclose all edges of the surface material, in order to provide protection upon handling and stacking of the operable partition. The panel frames will be made of a minimum of 1.6mm (16 gauge) steel with a power coated finish:
 - .1 Colour to be selected by Consultant from Manufacturers full range.
- .3 Vertical sound seals between panels will incorporate an alignment moulding made of aluminum. This moulding will be installed on the edge of each panel in order to ensure a good vertical sound seal and proper alignment when setting up the partition.

- .4 Horizontal seals must not exceed the panel width, to prevent damage while handling. Retractable bottom seals are made from formed steel, incorporating 6mm (1/4") vinyl strips for proper acoustical seal upon activating.
 - .1 Top seals shall be retractable and must be made from formed steel; incorporating 6 mm (1/4") vinyl strips for proper acoustical seal upon activating. They should be activating simultaneously with the bottom seals.
- .5 All vinyl and PVC trims shall match standard frame colors available from the color selector.
- .6 Pocket door
 - .1 Type II: Double leaf pocket door
 - .2 The pocket door shall have the same finish as the operable partition. Hinges shall project no more than 6mm (1/4") from the door frame. The door will operate with a turn-type handle. A spring-loaded mechanism will activate a 10mm (3/8") diameter steel rod at the top and at the bottom of the door. A plate anchored to the ground receives the lower stem.

2.4 COMPONENTS

- .1 Suspension system shall consist of clear anodized thermally treated architectural grade extruded aluminum track (painted steel track not acceptable) connected to the structural support by pairs of steel threaded rods provided by the manufacturer. Guide pins will ensure perfect alignment of track joints. Track design shall be clear anodized aluminum, provide precise alignment at the trolley running surfaces and provide integral support for adjoining ceiling, soffit, or plenum sound barrier. A section of track should be removable in order to make it possible for a panel to be removed from the track for later maintenance.
- .2 Each panel shall be supported by one trolley assembly consisting of four (4) steel ball bearing wheels nylon coated. Friction disc puck type carrier and track systems are not allowed. A report showing that a reliability test covering a distance of 160 Kilometers was completed and must be available on request.

2.5 PANEL FINISHES

- .1 Standard fabrics (colour shall be selected from manufacturer's standard colour selector). The fabric shall have an acrylic backing and a stain resistant coating.

2.6 OPERATION

- .1 Partitions shall be top supported, manually operated panels.
 - .1 Friction disc/puck type carrier and track systems are not allowed. Bottom horizontal seals will be operated by a removable handle located approximately 1066 mm (42") from the floor at panel edge. Operation of the seals requires no more than 180-degree turn of the handle. Horizontal bottom seals provide 51mm (2") nominal operating clearance in order to make manipulation of the panels easier and to accommodate a deflection of the support beam or out of level floor. A stabilizing pressure shall be exerted when lowering seals. Automatic or foot pedal type activation of seals is not acceptable.
 - .2 An expandable closure panel will ensure the final acoustical seal. It will have the same finish as the operable partition. A removable lever accessible from both sides of the partition will activate it. It shall compensate for out-of-plumb conditions or minor wall irregularities and provide a positive pressure seal to achieve maximum sound control. It will provide a minimum of 250 lbs. (113.4kg) seal force against the adjacent wall or pocket doors for optimal sound control. No permanently fixed, wall-mounted jambs are allowed.
- .2 **Acoustical integrity of the first panel will be ensured by:**
 - .1 Dual bulb seals against the wall.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for accordion folding partitions installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

- .1 Level tracks and fasten securely to header.
- .2 Install partition in accordance with manufacturer's printed instructions.
- .3 Touch up damaged finishes, repair damage to partitions to match original finish.
- .4 Clean movable partition system and protect from damage.
- .5 Adjust and leave partitions in smooth operating conditions.

3.3 SITE QUALITY CONTROL

- .1 Site Test:
 - .1 Provide site sound performance report as requested by Consultant.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Toilet accessories.
 - .2 Bath accessories.
 - .3 Laundry accessories.
 - .4 Hygiene and custodial accessories.

1.2 RELATED REQUIREMENTS

- .1 Section 06 10 53 - Miscellaneous Rough Carpentry
- .2 Section 09 21 16 - Gypsum Board Assemblies
- .3 Section 09 22 16 - Non-Structural Metal Framing
- .4 Section 26 05 00 - Common Work Results for Electrical

1.3 DEFINITIONS

- .1 Accessible washroom: An individual washroom, containing a single toilet and lavatory, designed to accommodate a variety of users without an attendant.
- .2 Environmental product declaration: Third-party verified documentation with the supporting product category rule and life cycle assessment information, including at least a cradle-to-gate scope. Prepared in accordance with ISO 14025, ISO 14040, ISO 14044, and EN 15804 or ISO 21930.
- .3 Industry average environmental product declaration: Developed by an industry association and represents the average product of multiple companies. Products covered by industry average environmental product declarations are required to follow the same product category rule. Industry average environmental product declarations cannot represent a certain manufacturer or its product. Industry average environmental product declarations may be referred to as "industry-wide environmental product declarations" or "generic environmental product declarations".
- .4 Product-specific type III environmental product declaration: Provides data on one product made by one manufacturer, but can involve multiple factories. Product-specific type III environmental product declarations can cover a product produced by a manufacturer in several plants throughout the world if all plants use the same processes. Product-specific environmental product declarations cannot represent several products and several manufacturers.
- .5 Universal washroom: An individual washroom, containing a single toilet and lavatory, designed to accommodate a variety of users (such as a person with disabilities with an attendant or a child with a parent).

1.4 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM A240/A240M-24, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - .2 ASTM A269/A269M-24, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

- .3 ASTM A480/A480M-24, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat Resisting Steel Plate, Sheet, and Strip
- .4 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- .5 ASTM A666/A666M-24, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
- .6 ASTM A743/A743M-21, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
- .7 ASTM B86-23, Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings
- .8 ASTM B221-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
- .9 ASTM B221M-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
- .10 ASTM C1503-24, Standard Specification for Silvered Flat Glass Mirror
- .11 ASTM F2285-22, Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-12.5-M86, Mirrors, Silvered
- .3 CSA Group (CSA):
 - .1 CSA B651-18, Accessible design for the built environment
 - .2 CSA/ASC B651:23, Accessible design for the built environment
- .4 ULC Standards (ULC):
 - .1 CAN/ULC-S109-14, Standard Method for Flame Tests of Flame-Resistant Fabrics and Films

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with Section 06 10 53 - Miscellaneous Rough Carpentry and Section 09 22 16 - Non-Structural Metal Framing for framing, blocking, or backing required to anchor wall-mounted accessories.
 - .2 Coordinate with Section 09 21 16 - Gypsum Board Assemblies for installation of manufacturers' steel anchor plates before installing gypsum board.
 - .3 Coordinate with Section 26 05 00 - Common Work Results for Electrical for connection to electrical systems.
 - .4 Deliver inserts and rough-in frames to work site at appropriate time for building-in. Provide templates, details, and instructions for building in anchors and inserts.
- .2 Pre-installation meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by the Consultant, and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review installation and substrate conditions.
 - .4 Coordinate with other Subcontractors.
 - .5 Review manufacturer's instructions and warranty requirements.
 - .6 Confirm exact locations with the Consultant.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: Product literature and data sheets for each accessory, including product characteristics, performance criteria, physical sizes, finishes, and limitations.
- .3 Shop drawings:
 - .1 Show location of each component, dimensioned plans and elevations, mounting heights, and attachment details.
 - .2 Show rough-in frames for recessed and semi-recessed installations, and each type of associated wall construction.
 - .3 Show locations and sizes of framing, blocking, or backing required for wall-mounted accessories, including concealed items specified in other sections.
- .4 Samples:
 - .1 Samples for selection: Full range of samples, representing available colours, patterns, textures, and finishes.
- .5 Manufacturer's instructions:
 - .1 Special delivery, storage, and handling requirements.
 - .2 Installation instructions.
 - .3 Recommended sequencing.
 - .4 Cleaning procedures.

1.7 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance data:
 - .1 Include, in the operation and maintenance manual, manufacturer's operation and maintenance instructions and recommended cleaning materials and methods.
 - .2 Include list of regional suppliers for paper towels, [specialty toilet paper rolls,] and similar disposable products which are compatible with the specified toilet and bath accessories.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Tools:
 - .1 Submit four master keys for keyed accessories.
 - .2 Supply special tools required for assembly, disassembly, and maintenance of accessories.

1.9 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- .1 Regulatory requirements:
 - .1 Accessibility: Provide toilet and bath accessories in accordance with CSA B651.
 - .1 One-handed operation:
 - .1 using a closed fist position, or
 - .2 another method of operation that does not require tight grasping, pinching, or twisting of the wrist, and
 - .3 operating force: 22 N maximum.
 - .2 Operating controls: Luminance (colour) contrasting with background.
 - .2 Products requiring electrical connection:
 - .1 Listed and certified by a certification body accredited by the Standards Council of Canada (SCC) or acceptable to authority having jurisdiction as suitable for purpose specified.
- .2 Provide rough-in frames for accessories semi-recessed or recessed into walls.
- .3 Manufacturer's identification labels not permitted on visible surfaces.

2.2 MATERIALS

- .1 Aluminum, extruded: To ASTM B221 or ASTM B221M.
- .2 Steel sheet: To ASTM A653/A653M, commercial quality galvanized, with ZF120 coating designation.
 - .1 Sustainability characteristics:
 - .1 Recycled content: Minimum 50% post-consumer and pre-consumer.
- .3 Stainless-steel sheet: To ASTM A240/A240M or ASTM A666/A666M, Type 304.
 - .1 Sustainability characteristics:
 - .1 Recycled content: Minimum 90% post-consumer and pre-consumer.
 - .2 Finishes: To ASTM A480/A480M.
 - .1 No. 4 Finish, general purpose polished finish.
- .4 Stainless-steel tubing: To ASTM A269/A269M, seamless, Grade TP304.
- .5 Stainless-steel castings: To ASTM A743/A743M.
 - .1 Sustainability characteristics:
 - .1 Recycled content: Minimum 90% post-consumer and pre-consumer.
- .6 Zinc aluminum magnesium and copper alloy (Zamac) castings: To ASTM B86.
- .7 Mirror glass: To CAN/CGSB-12.5, mirror select quality.
 - .1 Classification: 1B, float glass for high humidity use.

2.3 TOILET ACCESSORIES

- .1 Back supports (**BR**):
 - .1 Description: Grab bar shall be Type-304 stainless steel with satin finish. Grab bar shall have 18-gauge 1.2mm (18-gauge) wall thickness and 30mm (1-1/4") outside diameter. Clearance between the grab bar and wall shall be 210mm (8-1/4"). Concealed mounting flanges shall be 3mm (11-gauge) stainless steel plate, 50 x 80mm (2" x 3-1/8"), and equipped with six screw holes for attachment to wall. Flange covers shall be 0.8mm (22-gauge) stainless steel, 85mm (3-1/4") diameter, and shall snap over mounting flanges to conceal mounting screws. Ends of grab bar shall pass through concealed mounting flanges and be heliarc welded to form one structural unit. Grab bar shall be equipped with a 360 x 160 x 40mm (14-1/4" x 6-3/8" x 1-5/8") solid plastic laminate (white) backrest.
 - .2 Acceptable Manufacturer:
 - .1 Frost, Model: 1028
 - .2 Bobrick, Model: B-5892
- .2 Coat hooks (**HC & HCB**):
 - .1 Design/performance criteria:
 - .1 Maximum protrusion from wall: 40 mm.
 - .2 Anti-ligature design.
 - .2 Material: Stainless steel.
 - .1 Finishes: Satin.
 - .3 Acceptable Manufacturer:
 - .1 Frost, Model: 1138-S
 - .2 Bobrick, Model: B76717
 - .3 Bradley, Model: 9114
- .3 Combination paper towel dispenser / waste receptacles (**DPT**):
 - .1 Lockable access door and continuous, full-height stainless-steel hinge.
 - .1 Performance/design criteria:
 - .1 Towel dispenser: Operable with one hand to dispense towels.
 - .2 Material: Stainless-steel sheet, minimum [0.79] mm thick.
 - .1 Finishes: Satin.
 - .3 Mounting: Surface.
 - .4 Nominal dimensions: 430mm wide x 1430 mm high x 190 mm deep.
 - .5 Towel dispenser operation: Manual.
 - .6 Paper towel type: Roll or Folded.
 - .7 Removable waste receptacle: Galvanized.
 - .8 Waste capacity: 45L minimum.
 - .2 Acceptable Manufacturer:
 - .1 Frost, Model: 422-C
 - .2 Bobrick, Model: B-3949
 - .3 Bradley, Model: 237-11
- .4 Feminine napkin disposal bins (**WSN**):
 - .1 With self-closing continuous-hinged door.
 - .1 Door signage: English napkin disposal label embossed on lid.
 - .2 Mounting: Surface.
 - .3 Material: Stainless-steel sheet, minimum 0.79 mm thick.
 - .1 Finishes: Satin
 - .4 Removable receptacle: plastic, fitted with spring clip for deodorizer block.
 - .2 Acceptable Manufacturer:
 - .1 Frost, Model: 641
 - .2 Bobrick, Model: B-9254
 - .3 Bradley, Model: 4722-15

- .5 Grab bars:
 - .1 Performance/design criteria:
 - .1 Slip-resistant, free of sharp or abrasive elements.
 - .2 Wall-mounted grab bars: 35 to 45 mm clearance from adjacent walls.
 - .3 Rotation within fittings is not permitted.
 - .4 Resist 1.3 kN minimum load in any direction.
 - .5 30% Luminance (colour) contrasted with background.
 - .2 Mounting: Surface-mounted with concealed screw attachment.
 - .3 Material: Stainless-steel tubing, 38 mm diameter × minimum 0.76 mm wall thickness, with welded 50 mm flanges.
 - .1 Finishes: Peened, sand-paper-like
 - .4 Shapes: Straight & L
 - .5 Types:
 - .1 Straight Shapes:
 - .1 **(GB1)**: 610mm Long
 - .1 Acceptable Manufacturer:
 - .1 Frost, Model: 1001-NP24
 - .2 Bobrick, Model: B-6806x24
 - .3 Bradley, Model: 812-001-24
 - .2 **(GB2)**: 1070mm Long
 - .1 Acceptable Manufacturer:
 - .1 Frost, Model: 1001-NP42
 - .2 Bobrick, Model: B-6806x42
 - .3 Bradley, Model: 812-001-42
 - .2 L-Shaped:
 - .1 **(GBL1)**: 750mm x 750mm
 - .1 Acceptable Manufacturer:
 - .1 Frost, Model: 103-NP30x30
 - .2 Bobrick, Model: B-6898.99
 - .3 Bradley, Model: 812-057
 - .2 **(GBL2)**: 750mm x 1000mm
 - .1 Acceptable Manufacturer:
 - .1 Frost, Model: 1003-SP40x30
 - .2 Bobrick, Model: B-5854.99
 - .6 Mirrors, framed **(MR)**:
 - .1 Face: Mirror glass, 6.0] mm thick.
 - .2 Frame material: Stainless-steel, one-piece, welded corners ground and polished, satin polished.
 - .3 Mounting: Surface-mounted.
 - .4 Fasteners: concealed.
 - .5 Nominal dimensions: 460mm wide × 915 mm high.
 - .6 Acceptable Manufacturer:
 - .1 Frost, Model: 941-1836
 - .2 Bobrick, Model: B-165 1836
 - .3 Bradley, Model: 781-1836
 - .7 Shelves **(SH)**:
 - .1 Fixed shelves with hemmed edges.
 - .1 Mounting: Surface.
 - .2 Material: Stainless-steel sheet.
 - .1 Shelves: 1.3 mm thick minimum.
 - .2 Brackets: 1.6 mm thick minimum.
 - .3 Finishes: Satin.
 - .3 Nominal dimensions: 45.7cm W x 8.1cm H x 9.9cm D (18"W x 3.2"H x 3.9"D)

- .4 Acceptable Manufacturer:
 - .1 Frost, Model: 950-4x18
 - .2 Canadian Washroom Products, Model: MS-18
- .8 Soap dispensers (**SD**): With tamper-resistant filler lock.
 - .1 Material: Stainless-steel sheet, 0.95 mm thick.
 - .2 Soap container: 1L tank.
 - .3 Mounting: Surface.
 - .4 Soap type: Liquid.
 - .5 Spout length: 65mm nominal.
 - .6 Operation: Manual and operable with one hand to dispense soap on palm of that hand.
 - .7 Acceptable Manufacturer:
 - .1 Frost, Model: 708-A
 - .2 Bobrick, Model: B-2111
 - .3 Bradley, Model: 6563
- .9 Toilet tissue dispensers (**DTP**): With hinged front panel, refill indicator slot, and lockable access.
 - .1 Material: Stainless-steel sheet, 0.95 mm thick.
 - .1 Finishes: Satin
 - .2 Toilet tissue type: Roll, under spring tension for controlled delivery.
 - .3 Capacity:
 - .1 Rolls: One roll, 500 double-ply sheets.
 - .4 Acceptable Manufacturer:
 - .1 Frost, Model: 165
 - .2 Bobrick, Model: B-4288
 - .3 Bradley, Model: 5402

2.4 BATH ACCESSORIES

- .1 Shower Curtains & Rod (**SCR**):
 - .1 Shower curtains: With one stainless-steel curtain holdback hook and chain at each curtain.
 - .1 Performance/design characteristics:
 - .1 Anti-bacterial properties.
 - .2 Fire-resistant to self-extinguishing.
 - .2 Material:
 - .1 Vinyl: 0.33 mm thick, opaque.
 - .2 Colour: White
 - .3 Acceptable Manufacturer:
 - .1 Frost, Model: 1143-503
 - .2 Bobrick, Model: 204-3
 - .3 Bradley, Model: 9537
 - .2 Shower curtain rods: With minimum twelve shower curtain hooks.
 - .1 Performance/design criteria:
 - .1 Designed to withstand minimum 0.9 kN downward force.
 - .2 Material: 32mm diameter stainless-steel tubing with minimum 1.3mm wall thickness.
 - .1 Finishes: Satin.
 - .3 Rod shape: Straight
 - .4 Nominal rod length: 1525.
 - .5 Wall flanges:
 - .1 Material: 75 mm diameter stainless-steel, 1.3mm thick minimum.
 - .2 Finishes: Matching curtain rod.
 - .6 Acceptable Manufacturer:
 - .1 Frost, Model: 1145
 - .2 Bobrick, Model: B-6047
 - .3 Bradley, Model: 9539

- .2 Shower seats:
 - .1 Performance/design criteria:
 - .1 Rated load: 225kg minimum.
 - .2 Smooth exposed edges.
 - .2 Seat: Slotted or perforated to drain water.
 - .1 Material: Solid phenolic, minimum 13 mm thick.
 - .1 Colour: White.
 - .2 Shape: Rectangular.
 - .3 Frame: Folding.
 - .1 Material: Stainless-steel tubing, minimum 1.3 mm wall thickness].
 - .1 Finishes: Satin.
 - .4 Mounting: Wall.
 - .5 Acceptable Manufacturer:
 - .1 Frost, Model: 972
 - .2 Bobrick, Model: B-5191
 - .3 Bradley, Model: 9562
- .3 Soap holders (**ST**): Self-draining.
 - .1 Material: Stainless steel.
 - .2 Mounting: Surface.
 - .3 Nominal dimensions: 160mm wide × 160mm high × 45mm deep.
 - .4 Acceptable Manufacture:
 - .1 Frost, Model: 1136
 - .2 Bobrick, Model: B-680
 - .3 Bradley, Model: 9014

2.5 HYGIENE AND CUSTODIAL ACCESSORIES

- .1 Mop and broom holders with shelf (**US**):
 - .1 Material: Stainless-steel sheet, 1.3 mm thick minimum.
 - .1 Finishes: Satin
 - .2 Mop and broom holders: Three, cam-style, spring loaded, anti-slip surface, mounted at front edge of shelf at 265 mm on-centre.
 - .3 Rag hooks: Four, stainless-steel, 1.6 mm thick minimum, riveted to front edge of shelf between mop holders.
 - .4 Shelf dimensions: [915] mm long × [200] mm wide × [38] mm deep.
 - .5 Drying rod: 6 mm diameter stainless-steel, mounted below shelf.
 - .6 Acceptable Manufacturer:
 - .1 Frost, Model 1115
 - .2 Bobrick, Model: B-239x34
 - .3 Bradley, Model: 9933

2.6 FABRICATION

- .1 Weld and grind joints of fabricated components flush and smooth. Fabricate with mechanical fasteners only where acceptable to the Consultant.
- .2 Fabricate manufactured units so exposed metal edges are safe to touch, rolled or smooth finished, and free from burrs.
- .3 Wherever possible form exposed surfaces from a single sheet, free of visible joints.
- .4 Brake form sheet metal work with approximately 1.5 mm radius bends.
- .5 Form surfaces flat without distortion, scratches, or dents.

- .6 Back paint components where contact is made with building finishes where electrolysis could otherwise occur.
- .7 Factory assemble components and package with anchors and fittings.
- .8 Provide steel anchor plates and components for installation on studding and building framing.

2.7 ACCESSORIES

- .1 Fasteners: Corrosion-resistant, tamper-resistant screws and bolts.
 - .1 Expansion shields: Manufacturer-recommended for component and its intended use.
 - .2 Exposed fasteners: Not acceptable.
- .2 Anchor plates: Steel sheet purpose-built plates with threaded studs or plugs.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Verify walls and partitions have framing, blocking, backing, or anchor plates where required.

3.2 INSTALLATION

- .1 Install accessories where located on Drawings, in accordance with manufacturer's instructions and reviewed Shop Drawings.
 - .1 Install accessories in accessible spaces in accordance with CSA B651.
- .2 Secure accessories plumb, level, and rigidly in place.
 - .1 Concrete: Use bolts with expansion sleeves set into drilled holes.
 - .2 Hollow masonry units: Use toggle bolts drilled into cell cavity.
 - .3 Solid masonry: Use bolts with expansion sleeves set into drilled holes.
 - .4 Solid stone masonry: Use bolts with expansion sleeves set into drilled holes.
 - .5 Existing gypsum board walls: Use toggle bolts drilled into wall cavity.
 - .6 Existing plaster walls: Use toggle bolts drilled into wall cavity.
 - .7 Toilet [and shower] compartments: Use male-to-female through bolts.
 - .8 Hollow wall anchors are not permitted.
- .3 Install grab bars with anchors provided by grab bar manufacturer.
- .4 Centre mirrors over lavatories.
- .5 Fill units with necessary supplies shortly before final cleaning.

3.3 ADJUSTING

- .1 Adjust accessory components for correct function and operation in accordance with manufacturer's instructions.
 - .2 Lubricate moving parts to operate smoothly and fit accurately.
-

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning.
- .2 Waste management:
 - .1 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal.

3.5 PROTECTION

- .1 Protect partially installed and completed work from damage in accordance with Section 01 76 00 - Protecting Installed Construction.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 standard metal lockers

1.2 RELATED REQUIREMENTS

- .1 Section 06 10 53 - Miscellaneous Rough Carpentry

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM A240/A240M-23a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - .2 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .3 ASTM A1008/A1008M-21, 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
 - .4 ASTM D6578/D6578M-18, Standard Practice to Determine Graffiti Resistance
- .2 CSA Group (CSA):
 - .1 CSA B651-18, Accessible design for the built environment
 - .2 CSA/ASC B651:23, Accessible design for the built environment

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with Section 06 10 53 - Miscellaneous Rough Carpentry for locker base requirements and blocking locations in partitions.
- .2 Pre-Installation Meetings: Conduct a site meeting in accordance with Section 01 31 19 – Project Meetings and attended by the Consultant, and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review installation and substrate conditions.
 - .4 Coordinate with other Subcontractors.
 - .5 Review manufacturer's instructions and warranty requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Product literature and data sheets for metal lockers and operating hardware, including product characteristics, performance criteria, physical sizes, finishes, and limitations.
- .3 Shop Drawings:
 - .1 Show locker configurations, elevations of groups of lockers, metal thicknesses, factory fabricating and site assembly methods, assembled banks of lockers, tops, rods, hooks, shelves, bases, trims, filler panels, end panels, back panels, doors, handles, locking methods, ventilation and perforation details, and finishes.

- .2 Show locations and minimum sizes of blocking and nailers. Include concealed blocking and reinforcement specified in other Sections.
- .3 Indicate proposed locker numbering sequences.
- .4 Samples:
 - .1 Samples for initial selection: Colour cards representing available colours, patterns, textures, perforations, and finishes.
 - .1 Submit samples for:
 - .1 locker bodies; and
 - .2 number plates.
 - .2 Samples for verification: Manufacturer's standard size samples to verify selected colours, patterns, and textures, perforations, and finishes.
 - .1 Submit samples for:
 - .1 each metal colour, on actual material; and
 - .2 each number plate type.
 - .5 Manufacturer's Instructions:
 - .1 Special delivery, storage, and handling requirements.
 - .2 Installation instructions.
 - .3 Recommended sequencing.
 - .4 Cleaning procedures.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data:
 - .1 Include, in the operation and maintenance manual, manufacturer's maintenance and recommended cleaning materials and methods.
 - .2 Submit list of lock combinations for fixed locking mechanisms.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements, and:
 - .1 Deliver lockers pre-assembled, complete with required assembly hardware and assembly instructions.

PART 2 PRODUCTS

2.1 PERFORMANCE/DESIGN CRITERIA

- .1 Accessibility: Provide lockers that meet CSA/ASC B651 for operating controls and accessibility identification.
 - .1 Controls for operating lockers with one hand as follows:
 - .1 using a closed fist position, or
 - .2 another method of operation that does not require tight grasping, pinching, or twisting of the wrist, and
 - .3 door-opening force: 22 N maximum.
 - .2 Door handles: Luminance (colour) contrasting with background.
 - .3 Accessibility identification label: Identify accessible lockers with a permanent label of the International Pictogram of Access.
- .2 Manufacturer's identification labels not permitted on visible surfaces.

2.2 MATERIALS

- .1 Sheet Steel: To ASTM A1008/A1008M, galvanized, free of surface imperfections.
- .2 Sheet Stainless Steel: To ASTM A240/A240M, Type 304, free of surface imperfections.

2.3 METAL LOCKERS

- .1 Lockers: to CAN/CGSB-44.40, Type 1-Double width full-height locker Class 1 - One complete locker, freestanding
 - .1 Size: 610 mm wide x 455 mm deep x 1830 mm high, steel body. Comprised of sides, back top and bottom 24 gauge 0.60 mm (0.024") thick.
 - .2 Sides must be provided with stiffening ribs and back must be flanged.
 - .3 Bottom pan to provide positive drain in bottom
 - .4 Prefinished steel base. 20 gauge 0.90 mm (0.036") thick sheet steel
 - .5 Door Frame. Cold rolled not less than 16 gauge 1.5 mm (0.060") thick sheet steel formed to channel shape and horizontal members welded to vertical member
 - .6 Double vented doors c/w hasp for padlock. Cold rolled stretcher leveled sheet steel 20 gauge 0.90 mm (0.36") thick outer panel and 24 gauge 0.60 mm (0.024") thick inner panel spot welded together on 4 sides. Provide for recessed locking arrangement. Doors shall be set flush to frames.
 - .7 Interior dividers and shelves. 24 gauge 0.60 mm (0.24") thick cold rolled steel with channel formed fronts
 - .8 Trim. 22 gauge 0.76 mm (0.030") thick sheet steel except roll formed trim for which 20 gauge 0.90 mm (0.036") sheet steel is acceptable
 - .9 Hinges. Hang doors on 3 tamperproof butt hinges. Hinge pins shall allow 180 deg door swing
 - .10 Stainless steel name plates. Blank name plates to receive owner supplied names.
 - .11 Coat hooks (3) and coat rod.
 - .12 Prefinished metal sloped top
 - .13 Prefinished metal end and side closures
 - .14 Color(s)
 - .1 Will be selected from manufacturer's standard range.
 - .15 Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - .1 Gladiator series as manufactured by Hadrian
 - .2 Series 50 as manufactured by Lincora
 - .3 Alternate(s) as approved by the consultant.

2.4 FABRICATION

- .1 Fabricate assembled lockers and their components straight, square and true, rigid, without warp, with flat faces, and free of distortion and dents.
- .2 Fabricate finished lockers uniform in quality, clean, and free of defects that might affect their appearance or serviceability.
- .3 Fold back or shape exposed edges to provide safe, rounded edges.
- .4 Deburr and remove sharp edges from metal.
- .5 Fabricate frames with galvanized steel channel to form rigid, square structure. Form frames with integral continuous door stops on latch-and hinge-side vertical members. Include resilient bumpers for sound and vibration absorption.

- .6 Doors: Single-wall sheet galvanized steel construction.
 - .1 Punch or otherwise form louvers at top and bottom of doors for ventilation.
- .7 Side Panels: Form sides from sheet galvanized steel, pre-punch holes for assembly and for [shelf and] hardware attachment.
- .8 End Panels: Form end panels from same metal as side panels, without pre-punched holes except for attachment of end panels. Designed for concealed fastener installation.
- .9 Shelves: Form shelves from sheet [[steel] [galvanized steel] [stainless steel]] with pan construction and mount approximately 250 mm to 400 mm from tops of lockers and 380 mm from bottoms of lockers.
- .10 Mount three single-prong hooks at sides and back of locker or one double prong hook at back of locker. Mount hooks in accessible lockers at 1200 mm above floor.

2.5 FINISHES

- .1 Shop Finishing Methods:
 - .1 Clean, degrease, and neutralize steel components with phosphate, chromate, or similar treatment.
 - .2 Powder coat finish: Manufacturer's standard powder coating.
 - .1 Graffiti resistance score: To ASTM D6578/D6578M, average 5.0 minimum.
 - .3 Colours: One colour as selected by the Consultant from manufacturer's standard colour range.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Verify substrates and project conditions in accordance with Section 01 71 00 – Examination and Preparation.

3.2 INSTALLATION

- .1 Install lockers in accordance with manufacturer's instructions and reviewed Shop Drawings.
- .2 Securely fasten lockers to ground and walls.
- .3 Install wall trim around recessed locker banks.
- .4 Install filler panels (false fronts) where indicated on Drawings and where obstructions occur.
- .5 Install finished end and back panels to exposed ends and backs of locker banks.
- .6 Install number plates.

3.3 ADJUSTING

- .1 Adjust metal lockers for correct function and operation in accordance with manufacturer's instructions.
 - .2 Lubricate moving parts to operate smoothly and fit accurately.
-

3.4 CLEANING

- .1 Cleaning during work: Perform cleaning work according to the General and Special Condition requirements.
 - .1 Leave the premises clean at the end of each working day.
 - .2 Clean surfaces with a damp cloth and an approved non-abrasive cleaning product in accordance with manufacturer's instructions.
- .2 Final Cleaning: Remove excess materials, waste, tools, and equipment from the job site according to the general and special condition requirements.
- .3 Waste Management:
 - .1 Manage waste in accordance with Section 01 74 19 – Waste Management and Disposal.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Manually-operated roller window shades with single rollers.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM E2180-18, Standard Test Method for Determining the Activity of Incorporated Antimicrobial Agent(s) In Polymeric or Hydrophobic Materials
 - .2 ASTM G21-15e1, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN2-4.162-M80, Hospital Textiles – Flammability Performance Requirements
- .3 Health Canada (HC):
 - .1 SOR/2019-97, Corded Window Coverings Regulations
- .4 ULC Standards (ULC):
 - .1 CAN/ULC-S109-14, Standard Method for Flame Tests of Flame-Resistant Fabrics and Films
- .5 Window Covering Manufacturers Association (WCMA):
 - .1 ANSI/WCMA A100.1-2022, American National Standard for Safety of Corded Window Covering Products

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by the Consultant, manufacturer's site services representative, and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review installation and substrate conditions.
 - .4 Coordinate with other Subcontractors.
 - .5 Review manufacturer's instructions and warranty requirements.
- .2 Sequencing:
 - .1 Perform work of this section after completion of interior painting and other finishing work within the vicinity.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Product literature and data sheets for roller window shades, including product characteristics, performance criteria, physical sizes, finishes, [example warranty documentation,] and limitations.

- .3 Shop Drawings:
 - .1 Indicate product details, installation details, operational clearances, and relationship to adjacent Work.
 - .1 Indicate required clearances from glazing, and operating hardware (such as including cranks, handles, and locks) on operable glazed units, through entire operating range.
 - .2 Identify shade material on each roller, the shade material's orientation on the rollers, and seam and batten locations.
 - .3 Indicate constructed opening sizes on plans, elevations, and sections.
 - .4 Indicate remote-operation control station locations including drawings or graphics indicating which remote-operation controls which roller shades.
 - .2 Include a Location Schedule showing locations, sizes, and quantities of roller window shades. Use same room designations as the Drawings.
 - .3 Show locations and sizes of blocking reinforcement. Include concealed blocking and reinforcement specified in other sections.
- .4 Samples:
 - .1 Samples for initial selection: Full range of samples, representing available colours, patterns, textures, and finishes.
 - .1 Submit samples for:
 - .1 room darkening shade fabrics;
 - .2 light filtering fabrics; and
 - .3 exposed metal finishes.
- .5 Manufacturer's Instructions:
 - .1 Special delivery, storage, and handling requirements.
 - .2 Installation instructions.
 - .3 Recommended sequencing.
 - .4 Cleaning procedures.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Include, in the operation and maintenance manual, manufacturer's maintenance and operating instructions and recommended cleaning materials and methods.

1.6 QUALITY ASSURANCE

- .1 Mock-Ups: Install mock-ups in accordance with Section 01 43 00 - Quality Assurance.
 - .1 Install one operational mock-up of each specified roller window shade type.
 - .2 Locations: Acceptable to the Consultant.
 - .3 Acceptable mock-ups may remain as part of the Work.

1.7 WARRANTY

- .1 Submit warranty information in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Manufacturer Warranty: Manufacturer's standard warranty document, executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights the Owner may have under the Contract.
 - .1 Manufacturer's warranty period: 5 years.

PART 2 PRODUCTS

2.1 PERFORMANCE/DESIGN CRITERIA

- .1 Design blinds to:
 - .1 Allow wear-susceptible parts to be replaceable by either the user or the manufacturer.
 - .2 Permit effective disassembly of components to permit recycling of materials for which recycling markets exist.
 - .3 Include stamps on all major plastic components indicating composition code to facilitate recycling efforts.
 - .4 Mounting: Inside.
 - .1 Opaque shade materials: Provide minimum 51 mm clearance between shade cloth and inside face of glazing.
- .2 Anti-Microbial Requirements: To ASTM G21 and ASTM E2180, 'No Growth' results for fungi ATCC 9642, ATCC 9644, and ATCC 9645.
- .3 Single-Source Responsibility: Obtain each type of roller window shade and other components from one Supplier and a single manufacturer, or by manufacturers approved by the system manufacturer as compatible with other system components. Include all Products required to meet warranty requirements.
 - .1 Provide motor-operated blinds from the same Supplier and manufacturer, and of same quality and appearance as the manually-operated blinds.

2.2 REGULATORY REQUIREMENTS

- .1 Consumer Product Safety: In accordance with SOR/2019-97.
- .2 Flammability Requirements: In accordance with CAN/ULC-S109.
- .3 Products Requiring Electrical Connection: Listed and certified by a certification body accredited by the Standards Council of Canada or acceptable to authority having jurisdiction as suitable for purpose specified.

2.3 MANUALLY-OPERATED ROLLER WINDOW SHADES WITH SINGLE ROLLER

- .1 Chain-and-Clutch Operating Mechanisms: Continuous-loop bead chain and clutch that stops shade movement when bead chain is released, shade to be permanently adjusted and lubricated.
 - .1 Bead chains: #10 stainless steel rated to minimum 400 N breaking strength, with pull chain tensioning device in accordance with ANSI/WCMA A100.1.
 - .1 Loop length: Full length of roller shade.
 - .2 Limit stops: Allow shade to stop when chain is released. Provide limit stops to prevent shade from being raised or lowered too far.
 - .3 Chain-retainer type: Chain tensioner.
- .2 Rollers: Corrosion-resistant steel or extruded aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms, and weights and widths of shade bands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shade cloth for service.
 - .1 Roller drive-end location: Right side of interior face of shade.
 - .2 Direction of shade cloth roll: Regular, from back/exterior face of roller.
 - .3 Shade cloth-to-roller attachment: Manufacturer's standard method. Adhesive attachment is not acceptable.
- .3 Shade Material: Light filtering.

2.4 SHADE MATERIALS

- .1 Material: PVC-coated polyester.
- .2 Light Filtering Shades:
 - .1 Light filtering shade cloth openness:
 - .1 North elevation: 10%.
 - .2 East elevation: 5%.
 - .3 South elevation: 3%.
 - .4 West elevation: 1%.
- .3 Shade Cloth Bottom/Hem Bar: Steel or extruded aluminum. Provide shade bar exposed with endcaps.
- .4 Pattern/Colour: As selected by the Consultant from manufacturer's full colour range].

2.5 FINISHES

- .1 Exposed Metal Trim and Accessories: As selected by the Consultant from manufacturer's full colour range].

2.6 ACCESSORIES

- .1 Mounting Hardware: Provide corrosion resistant brackets or endcaps compatible with roller assembly, operating mechanism, installation accessories, mounting location, and conditions indicated. Provide hardware to allow field adjustment or removal of shade roller tube and other operable hardware components without removal of brackets and end-or centre supports.
- .2 Exposed Headbox Assembly: Rectangular, extruded aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure. Provide manufacturer's standard height fascia as required to conceal roller and shade band assembly when shade is fully open.
- .3 Front Fascia: L-shaped aluminum extrusion to conceal shade roller and hardware that snaps onto end caps without requiring exposed fasteners of any kind. Fascia can be mounted continuously across two or more shade bands. Provide manufacturer's standard height fascia as required to conceal roller and shade band assembly when shade is fully open.
- .4 Endcaps: Extruded aluminum with universal design suitable for mounting to window mullions. Provide size compatible with roller size. Provide end cap covers matching fascia/headbox finish.
- .5 Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel. Provide manufacturer's standard height fascia as required to conceal roller and shade band assembly when shade is fully open. Provide pocket with lip at lower edge to support acoustical ceiling panel.
- .6 Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
- .7 Chain Guards: Tested and meeting SOR/2019-97.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 there is no visual evidence of biological growth on roller shades.

3.2 INSTALLATION

- .1 Install roller window shades as indicated on Drawings in accordance with reviewed Shop Drawings and manufacturer's instructions.
- .2 Install roller window shades level, plumb, secure, and at proper height and location relative to window units.
- .3 Provide supplementary or miscellaneous items, including hardware, brackets, anchors, fasteners, and accessories required for a complete, finished installation.
 - .1 Install centre brackets, where required, to prevent headrail deflection.
 - .2 Install chain guards on all bead chains.
- .4 Isolate metal parts from direct contact with concrete, mortar, or dissimilar metals.
- .5 Adjust roller window shades for form, appearance, balance, and proper operating condition.

3.3 CLOSEOUT ACTIVITIES

- .1 Training:
 - .1 Appoint manufacturer's authorized representative to train Owner's maintenance personnel in accordance with Section 01 79 00 - Demonstration and Training.
 - .2 Instruct personnel to adjust, operate, and perform periodic maintenance on roller window shades.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 07 92 00 - Joint Sealants

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM A153/A153M-16a, Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
 - .2 ASTM A307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
 - .3 ASTM A490M-12, Standard Specification for High Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints Metric
 - .4 ASTM A653/A653M-18, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .5 ASTM A792/A792M-21a, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
 - .6 ASTM D523-14, Standard Test Method for Specular Gloss
 - .7 ASTM D822-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
 - .8 ASTM F3125/F3125M-22, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength
- .2 CSA Group (CSA):
 - .1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
 - .2 CSA S16:19, Design of Steel Structures
 - .3 CSA W59-18, Welded Steel Construction (Metal Arc Welding)
- .3 Canadian Sheet Steel Building Institute (CSSBI):
 - .1 CSSBI 30M-17, Standard for Steel Building Systems
 - .2 CSSBI Bulletin B15-17A, Snow, Wind and Earthquake Load Design Criteria for Steel Building Systems
 - .3 CSSBI Sheet Steel Fact Sheet #3-17, Care and Maintenance of Prefinished Sheet Steel Building Products
 - .4 CSSBI S8-18: Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products
- .4 Green Seal Environmental Standards (GS):
 - .1 GS-36-13, Green Seal Standard for Adhesives for Commercial Use
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)
- .6 The Master Painters Institute (MPI):
 - .1 Architectural Painting Specification Manual, [current edition]
 - .1 MPI #23, Oil Alkyd Primer
 - .2 MPI #79, Alkyd. Anti-Corrosive for Metal

- .7 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA):
 - .1 SMACNA 008-2007, IAQ Guideline for Occupied Buildings under Construction
- .8 ULC Standards (ULC):
 - .1 CAN/ULC-S107:2019, Standard Methods of Fire Tests of Roof Coverings

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, product literature and data sheets for metal building materials and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS SDS. Indicate VOC's:
 - .1 For sealant materials during application and curing.
 - .2 For adhesives.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate on drawings related provisions required for mechanical, electrical and other work.
 - .3 Submit complete calculated thermal design analysis based on ASHRAE zone method or tests certified by independent analysis signed and sealed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .4 Submit erection drawings in accordance with CSSBI 30M as follows:
 - .1 Erection drawings showing foundation loads, anchor bolt setting details [part numbers, connections and assembly details].
 - .2 Submit description of methods and sequence of erection [and type of equipment] proposed for use in erecting structural frame.
 - .5 Indicate details including cuts, copes, connections, holes, threaded fasteners, rivets and welds. Indicate welds by CSA welding symbols.
- .4 Certificates:
 - .1 Submit certification that building is in accordance with Contract requirements.
 - .2 Submit structural analysis certification of building system.
 - .3 Submit certification stating design criteria used and loads assumed in design, which places sole responsibility for design of building components with steel building systems manufacturer.
- .5 Manufacturer's Site Reports: Submit to Consultant manufacturer's written report, within 3 days of review, verifying compliance of work, as described in PART 3 - SITE QUALITY CONTROL.
- .6 Sustainable Design Submittals:
 - .1 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for the Project.
 - .2 Regional Materials: submit evidence that project incorporates required percentage of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for the Project.
 - .3 Low-Emitting Materials:
 - .1 Submit listing of [adhesives and sealants] [and] [paints and coatings] used in building, comply with VOC and chemical component limits or restriction requirements.

1.4 QUALITY ASSURANCE

- .1 Provide certification from steel building systems manufacturer that erector is qualified to erect system.
- .2 Site Meetings: as part of Manufacturer's Services described in PART 3 - SITE QUALITY CONTROL, schedule site visits, to review work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory work is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .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 Protect prefinished steel sheet during fabrication, transportation, site storage and installation in accordance with CSSBI Sheet Steel Fact Sheet #3.
 - .2 Handle and protect galvanized materials from damage to zinc coating.
 - .1 During storage space surfaces of galvanized materials to permit free circulation of air.
 - .3 Store materials off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .4 Store and protect metal building materials from [nicks, scratches, and blemishes.
- .4 Packaging Waste Management: Remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MANUFACTURER

- .1 This specification is based on Pre-Engineer Structures as manufactured by Robertson Building Systems.

2.2 SYSTEM DESCRIPTION

- .1 Type: rigid frame.
- .2 Roof Slope: minimum 16%.
- .3 Wall System: single skin panels with interior liner panels.
- .4 Roof System: standing seam panels with interior liner panel.

2.3 DESIGN CRITERIA

- .1 Design steel building system to withstand dead loads and live loads including sprinklers, mechanical and electrical systems, as indicated.

- .2 Maximum deflection:
 - .1 Roof cladding under full design load: 1/180 of clear span.
 - .2 Wall cladding under specified wind effects: 1/90 of clear span.
- .3 Thermal resistance: minimum R-20 for walls and minimum R-30 for roof.
- .4 Design building walls and roof to allow for thermal movement of component materials caused by ambient temperature range without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- .5 Ensure total absence of condensation on interior surfaces under following minimum condition:
 - .1 Interior: 22°C, 30% relative humidity (RH), still air.
 - .2 Exterior: -30°C, 25 km/h wind.
- .6 Ensure building is weathertight.
- .7 Provide for positive drainage to exterior of condensation occurring within wall construction and water entering at joints.
- .8 Design building enclosure elements to accommodate, by means of expansion joints, any movement in element itself and between element and building structure caused by structural movements without permanent distortion, damage to infills, racking of joints, breakage of seals, water penetration or glass breakage.

2.4 MATERIALS

- .1 Structural Steel: To CSA G40.20/G40.21, shop primed.
- .2 Bolts: To ASTM A307 complete with nuts and washers.
- .3 Welding materials: To CSA W59.
- .4 Shop Primer Paint: To MPI #23.
- .5 Steel Sheet, Zinc-coated: To ASTM A653/A653M, structural quality grade A with Z275 coating, regular spangle surface, passivated for unpainted finish and unpassivated for paint finish.
- .6 Steel Sheet, Aluminum-Zinc Alloy Coated: To ASTM A792/A792M, structural quality grade 33 with AZ150 coating, regular spangle surface, passivated for unpainted finish and unpassivated for paint finish.
- .7 Screws: Corrosion resistant purpose made, head colour to match attached sheet.
- .8 Plastic sealants and adhesives as recommended by plastics manufacturer.
- .9 Insulation: Refer to Section 07 21 13 – Board Insulation.
- .10 Insulation Adhesive: Purposely made for insulation type and steel liner sheet, incombustible after initial set.
- .11 Vapour Barrier and Sealing Tape: As recommended by steel building systems manufacturer.
- .12 Sealants: In accordance with Section 07 92 00 - Joint Sealants and as recommended by sealant manufacturer.
 - .1 Adhesives and Sealants: VOC limit 30 g/L maximum to SCAQMD Rule 1168.

2.5 COMPONENTS

- .1 Wall System:
 - .1 Exterior sheet-wall: Factory preformed steel sheet, zinc coated or [aluminum-zinc alloy coated prefinished from manufacturer's standard profiles. Include closures, gaskets, sealants, flashing and fasteners to effect weathertight installation.
 - .1 Cut ends of sheets square and clean.
 - .2 Basis of Design:
 - .1 Panel Profile (MC-1): PBU
 - .2 Panel Profile (MC-2): PBD
 - .2 Exterior corners-wall: of material to match finish and profile of adjacent cladding material, shop cut and brake formed to correct angle.
 - .3 Accessories to exterior wall cladding, brake or bend to shape, of material and finish to match wall cladding, comprising cap flashings, drip flashings, internal corner flashings, copings and closures for head, jamb, sill corners].
 - .4 Interior liner sheet-wall: factory preformed steel sheet, minimum .454 mm base metal thickness, zinc coated or aluminum-zinc alloy coated, prefinished of manufacturer's standard profile with interlocking side lap. Install sealant material in interlocking lap.
 - .1 Cut ends of sheets square and clean.
 - .2 Basis of Design:
 - .1 Panel Profile: PBR
 - .5 Sub-girts and clips: Factory preformed steel sheet, zinc coated or aluminum-zinc alloy coated.
- .2 Roof System:
 - .1 Exterior sheet-roof: To CSSBI S8, factory preformed steel sheet zinc coated or aluminum-zinc alloy coated, prefinished from manufacturer's standard profiles. Include closures, gaskets, sealants, flashing and fasteners to effect weathertight installation.
 - .1 Cut ends of sheets square and clean.
 - .2 Basis of Design:
 - .1 Panel Profile: Double-Lok
 - .2 Accessories to roof cladding: brake or bend to shape, of material and finish to match roof cladding or wall cladding where applicable, comprising cap flashings, drip flashings, coping and closures for corners, fascia, soffit.
 - .3 Sub-purlins and clips: factory preformed steel sheet, zinc coated or aluminum-zinc alloy coated.
 - .4 Interior sheet-ceiling: Factory preformed steel sheet, zinc coated or aluminum-zinc alloy coated, prefinished of manufacturer's standard profile, with interlocking side lap.
 - .1 Install sealant material in interlocking lap.
 - .2 Cut ends of sheets square and clean.
 - .3 Basis of Design:
 - .1 Panel Profile: PBR
 - .5 Diagonal web members: Factory preformed steel sheet, zinc coated or aluminum-zinc alloy coated shop cut and formed to profile from manufacturer's standard.
 - .6 Gussets, lateral spacers: Factory preformed steel sheet, zinc coated or aluminum-zinc alloy coated shop cut and formed to profile from manufacturer's standard.
- .3 Valley gutters:
 - .1 Form valley gutters from material and finish to match roof cladding material to size and profile with outlets as indicated. Provide:
 - .1 Support straps and fastenings,
 - .2 Flute fillers and sealants,
 - .3 Leaf screens and dams for outlets.
 - .4 Snow guards, if required for safety at access and exit doors.
 - .5 Eavestrough & Gutter Screen: Galvanized steel, minimum 50% of free area.

2.6 FABRICATION

- .1 Fabricate structural members in accordance with shop drawings and to CSA S16.
 - .1 Tolerance to CSSBI 30M
- .2 Provide holes for attachment of other work, as indicated.
- .3 Reinforce openings to maintain design strength.

2.7 FINISHES

- .1 Clean, prepare surfaces and shop prime structural steel to CSA S16[except where members are zinc coated or zinc-aluminum alloy coated or are to be encased in concrete].
- .2 Prefinished steel with factory applied polyvinylidene fluoride.
 - .1 Class F1S.
 - .2 Colour: selected by Consultant from manufacturer's standard range.
 - .3 Specular gloss: 30 units +/-5 in accordance with ASTM D523.
 - .4 Coating thickness: not less than 22 micrometers.
 - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822 as follows:
 - .1 Outdoor exposure period 2500 hours.
 - .2 Humidity resistance exposure period 5000 hours.
- .3 Prefinished steel with factory applied silicone modified polyester.
 - .1 Class F1S.
 - .2 Colour: selected by Consultant from manufacturer's standard range.
 - .3 Specular gloss: 30 units +/-5 in accordance with ASTM D523.
 - .4 Coating thickness: not less than 20 micrometers.
 - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units for less and erosion rate less than 20% to ASTM D822 as follows:
 - .1 Outdoor exposure period 1000 hours.
 - .2 Humidity resistance exposure period 1000 hours.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal building installation in accordance with manufacturer's written instructions.
 - .1 Inform [Consultant of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Consultant.

3.2 ERECTION

- .1 Do work in accordance with CSSBI 30M except where specified otherwise.
- .2 Erect structural frame in accordance with shop drawings and to CSA S16.
 - .1 Erection tolerances not to exceed those specified in CSSBI 30M.
- .3 Prepare galvanized structural steel surfaces for site welding by removing zinc before welding.
 - .1 After welding, chip away flux and prime with MPI #23.

- .4 Obtain written permission from Consultant before site cutting or altering of structural members.
- .5 Touch-up with shop primer bolts, rivets, welds and burned or scratched surfaces where exposed at completion of erection.
- .6 Install wall cladding assemblies ensuring completed installation.
- .7 Secure sub-girts to structural wall supports.
- .8 Secure roof cladding sheets to structural purlins.
 - .1 Terminate sheet ends over structural supports.
- .9 Secure side laps.
- .10 Continuously seal end and side laps.
- .11 Install roof assemblies ensuring completed installation.
- .12 Install interior wall liner panels to ensure continuous vapour and air barrier.
- .13 Install necessary closures, gaskets, sealants and flashings.
- .14 Install insulation and vapour retarder to maintain continuity of thermal and moisture protection to building elements and spaces.
- .15 Fit insulation closely around and behind electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .16 Keep insulation away from hot surfaces chimneys and gas vents.
- .17 Do not compress insulation to fit into spaces.
- .18 For roof system, apply insulation in ceiling to form continuous thermal barrier in conjunction with vapour barrier formed by ceiling panels.
- .19 For roof system, ensure continuous vapour/air barrier seal by pre-caulking joints of ceiling panel.

3.3 SITE QUALITY CONTROL

- .1 Manufacturer's Services:
 - .1 Obtain written report from manufacturer verifying compliance of work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Site Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's site services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review work, as directed in PART 1 - QUALITY ASSURANCE.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 This section covers the general requirements for Mechanical systems. Read all divisions of the building specifications.
- .2 The mechanical work shall consist of the supply and installation of complete and operable systems and shall include all necessary labour, plant, materials and incidentals for the work involved.
- .3 The mechanical work shall include all of Division, 21, 22 and 23 as noted on the drawings and specifications.
- .4 Refer to the electrical and controls drawings and specification and note exact scope of work required by mechanical trades.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements
- .3 Section 01 78 00 - Closeout Submittals
- .4 Section 01 45 00 - Quality Control
- .5 Section 08 31 00 – Access Doors – Mechanical & Electrical
- .6 Section 09 91 23 - Interior Painting
- .7 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
- .8 Section 26 60 10 – Powered Equipment Schedule

1.3 REFERENCES

- .1 General:
 - .1 All references, codes, regulation, by-laws, etc. as noted in the Specification for Divisions 21, 22 and 23 shall be the latest edition / revision, except where specific editions are specified.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings; submit drawings to the engineer for all equipment as outlined in the specifications and on the Mechanical drawings.
- .3 Shop drawings to show (as a minimum) (refer to equipment specification sections for details):
 - .1 Make & Model Number.
 - .2 Capacity.
 - .3 Dimensions.
 - .4 Installation arrangement.
 - .5 Plan View and sections.

- .6 Weights.
 - .7 Operating characteristics.
 - .8 Operating Performance.
 - .9 Performance curves showing the operating point of the equipment.
 - .10 Piping hook-ups.
 - .11 Construction details.
 - .12 Energy Efficiency Ratings.
 - .13 Sound Data.
 - .14 Mounting arrangements.
 - .15 Operating and maintenance clearances.
 - .16 Installation instructions.
 - .17 Electrical data and characteristics.
 - .18 Motor duty.
 - .19 Motor brand and model no.
 - .20 Wiring Diagrams.
 - .21 All miscellaneous equipment and accessories to complete the system.
 - .22 Schematic Flow Diagrams.
 - .23 Approvals.
- .4 Shop drawings and product data accompanied by:
- .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
- .5 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures use "Shop Drawing Submittal Stamping Sheet". Identify section and paragraph number.
- .6 The mechanical contractor shall ensure that equipment has been checked for conformance with all the requirements of the drawings and specifications and that the equipment has been coordinated with other equipment to which it is attached or connected, and that all dimensions have been verified to ensure the proper installation of equipment within the available space without interference with the work of other trades. All information on the shop drawings such as wiring diagrams, accessories and details must be specifically prepared for this project. Shop drawing containing information irrelevant to this project will be rejected for resubmission. Make sure that electrical, controls and structural co-ordination is complete before submitting drawings for approval
- .7 Closeout Submittals:
- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, Consultant before final inspection.
 - .3 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Operation instruction for systems and component.
 - .4 Description of actions to be taken in event of equipment failure.
 - .5 Valves schedule and flow diagram.
 - .6 Colour coding chart.
 - .4 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .5 Performance data to include:

- .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
- .2 Equipment performance verification test results.
- .3 Special performance data as specified.
- .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
 - .2 Make changes as required and re-submit as directed by Consultant.
- .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
 - .1 Engineer will provide 1 set of reproducible mechanical drawings. Mark changes as work progresses and as changes occur.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Engineer for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

1.5 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

1.6 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
 - .1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Material Delivery Schedule: coordinate delivery of material to suit proposed construction schedule.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Building Loads
 - .1 Before loading any part of the structure, make sure that the construction is sufficiently complete and that concrete has attained sufficient strength to support such loads.

1.8 SYSTEM STARTUP

- .1 Instruct Consultant and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service technician to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .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 aspects of its care and operation.

1.9 OPERATING INSTRUCTIONS AND MAINTENANCE DATA

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include the following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Names and addresses of nearest suppliers for all items included in maintenance manuals.
- .4 Print operating instructions and frame under glass or in approved laminated plastic.
- .5 Post instructions where directed.
- .6 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .7 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements
- .2 This section covers the materials and methods of workmanship of items that are common to more than one section of division 21, 22, and 23.
- .3 Verify installation and co-ordination responsibilities related to equipment and controls, as indicated.
- .4 Access doors in ducts: Refer to 08 31 00
 - .1 Manufactured from 2mm core thickness galvanized steel, c/w galvanized concealed hinges, positive locking screwdriver or cam lock, include neoprene sponge air seal all around.
 - .2 Standard of acceptance: Acudor, Miami Carey, Air-O-Metal, Krugar, Maxam, Nailor.

- .5 Other access doors: Refer to 08 31 00
 - .1 Flush mounted 610mmx610mm for body entry and 305mmx305mm or hand entry unless otherwise noted. Doors shall open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps. Steel shall be prime coated. Doors in fire rated assemblies shall be fire rated.
 - .2 Standard of acceptance: Le Hage, Zurn, Acudor, Maxam.

PART 3 EXECUTION

3.1 EQUIPMENT REQUIREMENTS AND INSTALLATION

- .1 Comply with division 1 for coordination of the work with other trades.
- .2 Carry out complete installation in such a manner that will permit equipment maintenance and disassembly by use of unions or flanges, will minimize disturbance to connecting piping and duct systems and will be free of interference with building structure or other equipment.
- .3 Extend inaccessible lubricating connections and sight glasses to accessible locations outside of housings or other restricted access spaces.
- .4 Install base mounted equipment on concrete housekeeping pads with chamfered edges. Make pads a minimum of 100mm high and 50mm larger than the equipment base dimensions all around.
- .5 Provide drain lines from equipment into local floor drains.
- .6 Line-up equipment, floor plates and ceiling plates with building walls wherever possible.
- .7 Assist the Electrical Trade to ensure proper connection, correct thermal overload selection, correct stop-start controls and interlocking.
- .8 Rigidly comply with manufacturer's instructions and recommendations for the installation of equipment. Where required, arrange and pay for the manufacturers' field engineer to supervise the installation of the equipment.

3.2 HANGERS & SUPPORTS

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and requirements of ULC C203.
- .2 Set inserts in position in advance of concrete work.
- .3 Support all equipment and piping from structural members. Where structural supports do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide supplementary structural members. Obtain approval before using expansion shields. Use minimum two shields for each hanger. **Do not suspend from metal deck.** Anchoring of piping and equipment shall be to manufacturers recommendations. Provide special supports for equipment where required, fabricated from welded steel structural members. Provide shop drawings and obtain their approval when requested.
- .4 Provide split adjustable steel ring hangers on piping NPS 50mm dia. and under and clevis type for NPS greater than 50mm dia. Use roller type hangers as required.
Provide rigid hangers, swing hangers or pipe rollers complete with bracing for hot & chilled water/glycol supply and return, domestic hot & cold water and hot water recirculation pipes in accordance with the following:

Hanger Type	Rigid	Swing	Pipe Roller
Pipe expansion to hanger rod length	<1/24	1/24-1/6	>1/6
Minimum rod length	305mm	305mm	305mm

- .5 Provide pipe roller stand on supplementary structural members where hangers cannot be used.
- .6 Provide spring hangers where required to offset expansion on horizontal runs which follow long vertical risers.
- .7 Use the smallest pipe size to determine spacing between pipe rack supports.
- .8 Use rod diameters and support spacing as shown in the following table except where specified otherwise:

Rod Diameter and Support Spacing Table

<u>Pipe Size</u> <u>(Nominal)</u>	<u>Maximum Support Spacing</u>		<u>Copper</u> <u>Pipe</u>
	<u>Rod</u> <u>Diameter</u>	<u>Steel Pipe</u>	
15mm	8mm	-	1525mm
20mm – 25mm	9.5mm	1830mm	1830mm
32mm	9.5mm	1830mm	1830mm
40mm	9.5mm	2750mm	2440mm
50mm	9.5mm	3050mm	2750mm
65mm – 80mm	9.5mm	3660mm	3050mm

- .9 Support plumbing piping in accordance with the more stringent requirements of authorities having jurisdiction, plumbing code, or as specified above.
- .10 Place support within 300mm of each horizontal elbow and within 600mm of each side of valve or tee.
- .11 Mild steel wall hooks may be used to support non-expanding piping. Allow 25mm minimum clearance for insulated pipe.
- .12 Provide riser clamps for all risers unless detailed otherwise.
- .13 Uninsulated copper piping, use copper hangers or 6mm lead crimped to hanger between copper and ferrous hanger.
- .14 Provide insulation protection shields:
 - .1 Insulated cold piping (Fluid Operating Temperature Range <4 deg. C to 15 deg. C):
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
 - .2 Insulated hot piping Fluid Operating Temperature Range 20 deg. C to 175 deg. C):
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.
- .15 Offset hanger pipe and structural attachments in such a manner that rod is vertical when piping is hot and equalize loads on all hangers where possible.

3.3 SLEEVES

- .1 Provide pipe sleeves at all points where pipes pass through masonry or concrete. Sleeves shall be at least 20 gauge core thickness galvanized sheet steel with lock seam joints.
- .2 Provide cast iron pipe sleeve with integral annular fin or steel pipe sleeves with annular fin continuously welded at midpoint where the sleeve passes through foundation walls or extends above finished floor.
- .3 Size sleeves to provide 6mm clearance all around, between sleeve and pipes or between sleeve and insulation. As a minimum where piping passes below footings, provide a clearance of at least 50mm between sleeve and pipe. Backfill around pipe sleeve up to underside of footing with concrete of the same strength as the footing. Do not embed pipe in concrete.
- .4 Terminate sleeves flush with vertical surface of concrete and masonry or 100mm above floors.
- .5 For pipes passing through roofs, provide cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction; caulk between sleeve recess and pipe; fasten roof flashing to clamp device; make water-tight durable joint.
- .6 Fill voids around pipes as follows:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors.
 - .2 Where sleeves pass through walls or floors, caulk space between insulation and sleeve or between pipe and sleeve with waterproof fire retardant non-hardening mastic.
- .7 Ensure no contact between copper tube or pipe and ferrous sleeve.
- .8 On any exterior wall penetrations, provide special modular mechanical closures, "Link-Seal" as manufactured by Thunderline Corporation, to provide a watertight seal between pipe and wall sleeve.
- .9 Fill future-use sleeves with easily removable filler.
- .10 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint.
- .11 Temporarily plug all pipe openings during construction.

3.4 FIRESTOPPING

- .1 All firestopping and smoke sealing (except for fire dampers) required for mechanical service penetrations of rated walls, floors and partitions shall be the responsibility of Division 7.
- .2 Fire Compartments are indicated on Architectural Drawings

3.5 ESCUTCHEONS AND PLATES

- .1 Provide escutcheons on exposed pipes passing through finished walls, partitions, floors and ceilings and secure to pipe or finished surface but do not secure to insulation. Inside diameter shall fit around the finished pipe or insulation. Outside diameter shall cover the opening or sleeve.

3.6 ACCESS DOORS

- .1 Supply access doors for furred ceilings or spaces for servicing equipment and accessories or for inspection of safety, operating, or fire devices for installation by the appropriate trade.

3.7 DIELECTRIC COUPLINGS

- .1 Provide wherever pipes of dissimilar metals are joined.
- .2 Provide insulating unions for pipe sizes 50mm and under; flanges for pipe sizes over 50mm.
- .3 Provide felt or rubber gaskets to prevent contact of dissimilar metals.

3.8 PAINTING REPAIRS AND RESTORATION

- .1 Painting of equipment and material installed under Division 21, 22 and 23 is not part of the mechanical work except as noted.
- .2 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .3 Prime and touch up marred finished paintwork to match original.
- .4 Restore to new condition, finishes which have been damaged.
- .5 Clean all uncoated metal surfaces such as piping, fittings, valves, and equipment and leave ready for painting.
- .6 Prime uncoated metal surfaces in areas exposed to view that will be inaccessible to painter after installation.
- .7 Assist painter to determine proper colour coding.

3.9 ANCHORAGE OF EQUIPMENT

- .1 Anchor all machinery and equipment. Install lift rings for all major items of equipment, if required.
- .2 Construct equipment supports of structural steel or steel pipe, securely braced. Use only welded construction. Bolt mounting plates to structure.
- .3 Anchoring by explosive charge inserts is not acceptable unless approved by the Consultant

3.10 CANNING OR SLEEVING OF OPENINGS & HANGER INSERTS

- .1 Provide all cans or forms required for openings in poured-in-place concrete to suit pipes or ducts etc. Locate each in place, well in advance of concrete pouring.
- .2 Where cutting of the building framing or envelope is required to suit the work of this division, mark out the exact dimensions and position of such work and obtain the approval of the Consultant before carrying out cutting.
- .3 Supply all sleeves and hanger inserts required for the work of this division.

3.11 PIPING EXPANSION LOOPS

- .1 Provide expansion loops or joints where required.
- .2 Securely anchor pipes to the building structure where necessary to provide proper expansion. Install pipe guides on each side of each expansion loop or joint.
- .3 Refer to section 23 05 16 Expansion Fitting and Loops for HVAC equipment.

3.12 SETTING AND ALIGNMENT

- .1 Employ a journeyman millwright to align all V belt drives and shaft coupling drives prior to start up.
- .2 Submit a certificate from the millwright certifying that the above work has been carried out.

3.13 EQUIPMENT LUBRICATION

- .1 Lubricate all equipment which has provision for lubrication, with the exception of factory sealed bearings which shall be checked for alignment and smooth operation.
- .2 Use the lubricant recommended by the manufacturer for the service for which the equipment is specified.
- .3 Maintain and adequately lubricate equipment furnished and operated before completion of the Contract until the completed work is handed over to, and accepted by, the Owner. Provide a cardboard tag, wired in place on the equipment showing the date of motor start-up, the last date of lubrication, and the lubricant used.

3.14 CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.15 FIELD QUALITY CONTROL

- .1 Testing Piping Systems:
 - .1 Conduct tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
 - .2 Conduct tests and pay for all associated work including making good and re-testing when required.
 - .3 Notify Consultant 48 hours in advance of date when tests will be conducted.
 - .4 Make sure all work has been tested and approved prior to insulating or concealing.
 - .5 Carry out tests in the presence of the Consultant and the Authority having jurisdiction.
 - .6 Forward written test results to the Consultant.
 - .7 Schedule of Tests:

<u>Service</u>	<u>Test</u>	<u>Testing</u>	<u>Duration</u>	<u>Duration</u>
	<u>Pressure</u>	<u>Fluid</u>		
Water Systems	200 psi	Water	2 hours	
Natural Gas	75 psi	Air	24 hours	
Drainage Systems	5 psi	Water	6 hours	
 - .8 Carry out tests on the natural gas system in accordance with applicable codes and regulations.
 - .9 Carry out tests on the water supply and drainage systems in accordance with governing bodies.
 - .10 Leave all work uncovered until completion of testing. However, should the construction schedule require that work be covered, carry out tests on portions of system prior to system covering. Give a minimum of 48 hours notice to Consultant prior to testing.
- .2 Testing HVAC Systems:
 - .1 Refer to Section 23 05 93 Testing, Adjusting and Balancing for HVAC Systems.
- .3 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field

- Reports as described in PART 1 - SUBMITTALS.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .4 Field Testing:
 - .1 If the field tests indicate that equipment supplied to the project does not meet specifications, laboratory certification of the potentially deficient equipment may be requested by the Owner. In the event that equipment does not meet specifications, the Contractor shall be responsible for the costs of the above laboratory tests, and all subsequent testing and correction required.

3.16 SYSTEMS COMMISSIONING

- .1 Refer to Section 01 91 13 General Commissioning (CX) requirements.
- .2 Refer to Section 01 91 31 Commissioning (CX) Plan.
- .3 Refer to Section 01 91 41 Commissioning: Training.
- .4 In addition to the commissioning requirement of the sections above provide:
 - .1 Commission all Mechanical systems (Plumbing, HVAC and Controls) or components to achieve:
 - .1 Systems which are in full, demonstrated, and documented working order, and
 - .2 The familiarization and instruction of Owner's operating staff to ensure they are capable of operating systems properly and maintaining ongoing systems performance.
 - .2 Give the following points particular emphasis:
 - .1 Provide clear, concise, yet comprehensive control sequence descriptions for all systems and components. These are important as they will form the basis for the systems performance test checklists.
 - .2 Provide system performance testing of all systems and components. Cover all modes of operation (e.g. summer/winter; occupied / unoccupied) and all specified control sequences, both for normal operations and abnormal conditions.
 - .3 If outside temperature, lack of full occupancy, or other factors prevent full performance testing of some functions, then testing, verifying, and documenting the performance of these functions may be carried out at an appropriate time during the 12 months after Substantial Performance.
- .5 Mechanical Contractor to assign a Mechanical Commissioning Coordinator to:
 - .1 Assign direct overall charge of commissioning to the mechanical commissioning coordinator. Use a Commissioning Coordinator who is fully qualified through practical experience, has a comprehensive knowledge of the interactive nature of building systems and their controls, understands the complete system, and who is available to carry the project through total completion. This person, a Principal or an employee of the Mechanical Contractor or hired from an outside source, shall be responsible for Commissioning, Demonstration to the Owner, and Certifications of Substantial and Total Performance. This person shall not be the Mechanical Contractor's superintendent.
- .6 Schedule, Commissioning Plan
 - .1 Contribute to the construction team's efforts to prepare and submit a schedule within two months after award of contract (integrated with general construction schedule) for the commissioning phase of the work. Show:
 - .1 completion dates for each trade in each major section of the building.

- .2 timing of the various phases of the commissioning, testing, balancing, and demonstration process.
 - .3 submission dates for the various documents required prior to verification of commissioning.
- .2 The Mechanical Contractor shall contribute to the preparation of the commissioning Plan. It is a description of how the commissioning process will be organized, scheduled, and documented. Indicate:
 - .1 The composition of the Mechanical Contractor's group representation to the Commissioning Team.
 - .2 A list of activities and proposed checklists required to commission the system and its subsystems.
 - .3 A schedule for each activity linked to the master project schedule to make possible the coordination necessary between trades and trade divisions.
- .3 The Mechanical Commissioning Coordinator shall review design intent and intended commissioning procedures with the commissioning team and submit a detailed plan identifying the orderly progression of the prestart commissioning check and subsequent commissioning performance check of each sub-system, leading to the ultimate commissioning of entire systems. This review shall be completed 6 months prior to substantial performance.
- .7 Field Testing
 - .1 If the field tests indicate that equipment supplied to the project does not meet specifications, laboratory certification of the potentially deficient equipment may be requested by the Owner. If equipment does not meet specifications, the Contractor shall be responsible for the costs of the above laboratory tests, and all subsequent testing and correction required.
- .8 System Completion
 - .1 Have the Mechanical Commissioning Coordinator provide written certification that each system is ready for start-up and that the following work is fully completed and checked.
 - .1 All systems physically installed.
 - .2 Permanent electrical connections
 - .3 Controls
 - .4 Vibration Isolation adjusted
 - .5 Filter systems
 - .6 Fan drives
 - .7 Duct Leakage Testing
 - .8 Duct cleaning
 - .9 Rotational checks
 - .10 Equipment lubrication
 - .11 Equipment Prestart Checks
 - .12 Chemical Cleaning
 - .13 Chemical Treatment
 - .14 All safety controls operational and tested
 - .15 Qualified personnel operating systems
 - .16 Manufacturers equipment start-up and commissioning reports by equipment supplier.
 - .17 All deficiencies recorded, reviewed by the commissioning team, and subsequently corrected.
- .9 System Activation
 - .1 System Activation is the stage at which the System Completion has been completed and the services (i.e. electrical power, hot water, chilled water, natural gas) have been connected and started. Perform an activation inspection so that the system is operational and ready for testing and balancing.

- .10 Testing, Balancing, and Adjusting
 - .1 Include the following:
 - .1 activation of all subsystems
 - .2 testing and adjustment of all subsystems
 - .3 major or composite system activation
 - .4 major or subsystem testing and adjustment
 - .2 As in the case of the System Completion Phase, record all deficiencies, review by the Commissioning team and, subsequently, correct. Repeat the process at the point of the deficiency before proceeding forward.
 - .3 This phase is concluded when the installation is in full working order and acceptable for use. Include the following:
 - .1 position all balance dampers in ductwork
 - .2 position all balance valves in piping systems
 - .3 make provisions for testing air pressures and flow rates
 - .4 set up air diffusers, registers, and grilles
 - .5 set up all automatic control valves/dampers and automatic temperature control devices
 - .6 set up fans and pumps
 - .7 plug all air pressure and flow measuring holes
 - .8 adjust vibration isolators as necessary
 - .9 correct problems revealed by Balancing Agency. Change fan speed and pitch as necessary
 - .10 a detailed check by a person having direct overall charge of commissioning This check must include all items and functions to be later demonstrated to the Owner's representatives.
 - .11 systems operation in the fire mode in the presence of the authorities having jurisdiction. Obtain a written statement/certificate of approval.
- .11 System Performance Verification
 - .1 Do not commence Verification of Commissioning by the commissioning team until System Activation and Testing, Balancing, and Adjusting has been completed. Submit test procedure completion certificates at the time of requesting the commencement of the verification procedure. Demonstrate to the commissioning team the following:
 - .1 Operation of all mechanical equipment
 - .2 Location of and opening and closing of all access panels
 - .3 Operation of all automatic control dampers and automatic temperature control devices
 - .4 Proper response of all variable air volume terminals, reheat coils, valves, etc...
 - .5 Fire damper operation
 - .6 Noise levels
 - .7 Exhaust systems
 - .2 At the completion of the system performance verification submit the following to the commissioning team:
 - .1 A letter certifying that all work specified under this contract is complete, clean, and operational in accordance with the specification and drawings
 - .2 A copy of verification certificates and signed checklists provided by the specialist trades for transmission to the Owner
 - .3 Record drawings
 - .4 A letter from the testing and balancing agency certifying that all necessary data for inclusion in operating and maintenance manuals has been received
- .12 Commissioning and Documentation
 - .1 Provide and coordinate commissioning documentation as described in Division 1.

3.17 DEMONSTRATION

- .1 Refer to Section 01 79 00 – Demonstration and Acceptance.
- .2 Consultant will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.

3.18 PROTECTION

- .1 Protect equipment and material during construction from the weather, moisture, dust, painting, plastering and physical damage. Cover all equipment with polyethylene plastic sheets during plaster or concrete work and clean and return to "as new" condition prior to Substantial Performance of the Work. Provide for repainting of marked or damaged surfaces as required. Refer to Equipment Specific Installation and Operation Manuals for proper receiving, storage, installation and protection of equipment during construction.
- .2 Mask or grease and cover machined surfaces. Securely cover equipment openings and open ends of piping, conduit, and ductwork as work progresses.
- .3 Any equipment that has operating parts, bearings, or machined surfaces that show signs of rusting, pitting, or physical damage will be rejected.

3.19 CLEAN-UP

- .1 At all times keep the premises free from accumulations of waste material caused by employees or work, and at the completion of the work, remove surplus materials and leave area "broom clean" or equivalent, unless otherwise specified.

END OF SECTION

.1 PART 1- GENERAL

1.2 SUMMARY

- .1 This section covers the general requirements for the new fire suppression systems for this project. Read all divisions of the building specifications.
- .2 The mechanical work shall consist of the supply and installation of complete and operable systems and shall include all necessary labour, plant, materials and incidentals for the work involved.
- .3 The Fire Suppression System work shall include all of division 21 as noted on the drawings and specifications.
 - .1 Work Shall Include (but not limited to) the following for a completely designed and operable system to meet the requirements of NFPA 13:
 - .1 Wet Piping Sprinkler Systems.
- .4 Refer to the electrical fire alarm drawings and specifications.

1.3 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements
- .3 Section 01 78 00 - Closeout Submittals
- .4 Section 01 45 00 - Quality Control
- .5 Section 09 91 23 - Interior Painting
- .6 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
- .7 Section 21 13 13 – Wet Pipe Sprinkler Systems
- .8 Section 28 31 00 – Fire Detection and Alarm

1.4 REFERENCES

- .1 General:
 - .1 All references, codes, regulation, by-laws, etc. as noted in the Specification for Divisions 21, 22 and 23 shall be the latest edition / revision, except where specific editions are specified.

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings: submit drawings to the engineer for all equipment as outlined in the specifications and on the sprinkler drawings.
- .3 Shop drawings to show (as a minimum) (refer to equipment specification sections for details):
 - .1 Make & Model Number.
 - .2 Capacity.
 - .3 Dimensions.

- .4 Installation arrangement.
 - .5 Plan View and sections.
 - .6 Weights.
 - .7 Operating characteristics.
 - .8 Operating Performance.
 - .9 Performance curves showing the operating point of the equipment.
 - .10 Piping hook-ups.
 - .11 Construction details.
 - .12 Energy Efficiency Ratings.
 - .13 Sound Data.
 - .14 Mounting arrangements.
 - .15 Operating and maintenance clearances.
 - .16 Installation instructions.
 - .17 Electrical data and characteristics.
 - .18 Motor duty.
 - .19 Motor brand and model no.
 - .20 Wiring Diagrams.
 - .21 All miscellaneous equipment and accessories to complete the system.
 - .22 Schematic Flow Diagrams.
 - .23 Approvals.
- .4 Shop drawings and product data accompanied by:
- .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
- .5 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures use "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .6 The sprinkler contractor shall ensure that equipment has been checked for conformance with all the requirements of the drawings and specifications and that the equipment has been coordinated with other equipment to which it is attached or connected, and that all dimensions have been verified to ensure the proper installation of equipment within the available space without interference with the work of other trades. All information on the shop drawings such as wiring diagrams, accessories and details must be specifically prepared for this project. Shop drawing containing information irrelevant to this project will be rejected for resubmission. Make sure that electrical, controls and structural co-ordination is complete before submitting drawings for approval
- .7 Closeout Submittals:
- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, Consultant before final inspection.
 - .3 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .4 Maintenance data to include:

- .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
- .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
 - .2 Make changes as required and re-submit as directed by Consultant.
- .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
 - .1 Engineer will provide 1 set of reproducible mechanical drawings. Mark changes as work progresses and as changes occur.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Engineer for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

1.7 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Material Delivery Schedule: coordinate delivery of material to suit proposed construction schedule.
- .2 Building Loads
 - .1 Before loading any part of the structure, make sure that the construction is sufficiently

complete and that concrete has attained sufficient strength to support such loads.

1.9 OPERATING INSTRUCTIONS AND MAINTENANCE DATA

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Names and addresses of nearest suppliers for all items included in maintenance manuals.
- .4 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .5 Post instructions where directed.
- .6 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .7 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements
- .2 This section covers the materials and methods of workmanship of items that are common to more than one section of division 21, 22, and 23.
- .3 Verify installation and co-ordination responsibilities related to equipment and controls, as indicated.
- .4 All materials used on this project shall be new and CSA approved unless noted otherwise.

PART 3 EXECUTION

3.1 HANGERS & SUPPORTS

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and requirements of ULC C203.
- .2 Set inserts in position in advance of concrete work.
- .3 Support all equipment and piping from structural members. Where structural supports do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide supplementary structural members. Obtain approval before using expansion shields. Use

minimum two shields for each hanger. Do not suspend from metal deck. Anchoring of piping and equipment shall be to manufacturers recommendations. Provide special supports for equipment where required, fabricated from welded steel structural members. Provide shop drawings and obtain their approval when requested.

- .4 Provide split adjustable steel ring hangers on piping NPS 2" dia. and under and clevis type for NPS greater than 2" dia. Use roller type hangers as required.
- .5 Use the smallest pipe size to determine spacing between pipe rack supports.
- .6 Use rod diameters and support spacing as shown in the following table except where specified otherwise:

Rod Diameter and Support Spacing Table

<u>Maximum Support Spacing</u>			
<u>Pipe Size (Nominal)</u>	<u>Rod Diameter</u>	<u>Steel Pipe</u>	<u>Copper Pipe</u>
NPS 1/2"	5/16"	-	5 ft.
NPS 3/4" - 1"	3/8"	6 ft.	6 ft.
NPS 1 1/4"	3/8"	6 ft.	6 ft.
NPS 1 1/2"	3/8"	9 ft.	8 ft.
NPS 2"	3/8"	10 ft.	9 ft.
NPS 2 1/2" - 3"	3/8"	12 ft.	10 ft.
NPS 4"	5/8"	14 ft.	11 ft.
NPS 6"	3/4"	16 ft.	-

- .7 Support piping in accordance with the more stringent requirements of authorities having jurisdiction, plumbing code, or as specified above.
- .8 Place support within 12" of each horizontal elbow and within 24" of each side of valve or tee.
- .9 Provide riser clamps for all risers unless detailed otherwise.
- .10 Provide insulation saddles for insulated pipe and prefabricated insulation shields with high density insulation. Grinnel Fig. Nos. 160 to 167.

3.2 SLEEVES

- .1 Provide pipe sleeves at all points where pipes pass through masonry or concrete. Sleeves shall be at least 20 gauge core thickness galvanized sheet steel with lock seam joints.
- .2 Provide cast iron pipe sleeve with integral annular fin or steel pipe sleeves with annular fin continuously welded at midpoint where the sleeve passes through foundation walls or extends above finished floor.
- .3 Size sleeves to provide 1/4" clearance all around, between sleeve and pipes or between sleeve and insulation. As a minimum where piping passes below footings, provide a clearance of at least 2" between sleeve and pipe. Backfill around pipe sleeve up to underside of footing with concrete of the same strength as the footing. Do not embed pipe in concrete.
- .4 Terminate sleeves flush with vertical surface of concrete and masonry or 4" above floors.
- .5 Fill voids around pipes as follows:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors.

.2 Where sleeves pass through walls or floors, caulk space between insulation and sleeve or between pipe and sleeve with waterproof fire retardant non-hardening mastic.

.6 On any exterior wall penetrations, provide special modular mechanical closures, "Link-Seal" as manufactured by Thunderline Corporation, to provide a watertight seal between pipe and wall sleeve.

.7 Fill future-use sleeves with easily removable filler.

.8 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint.

.9 Temporarily plug all pipe openings during construction.

3.3 COORDINATION OF PENETRATIONS

.1 Coordinate all penetrations and openings required for mechanical services routed through concrete assemblies

.2 All core drilling of slabs for installation of piping shall be by division 21.

.3 For all openings, penetrations, where core drilling is necessary; all x-ray services as required will be provided by this section to identify structural steel dowels, cables, rebar, etc. prior to core drilling of floor and routing of plumbing, piping, ductwork and equipment to suit final field layout / routing.

3.4 FIRESTOPPING

.1 All firestopping and smoke sealing required for mechanical service penetrations of rated walls, floors and partitions shall be the responsibility of Division 7.

.2 Fire Compartments are indicated on Architectural Drawings

3.5 ESCUTCHEONS AND PLATES

.1 Provide escutcheons on exposed pipes passing through finished walls, partitions, floors and ceilings and secure to pipe or finished surface but do not secure to insulation. Inside diameter shall fit around the finished pipe or insulation. Outside diameter shall cover the opening or sleeve.

3.6 ACCESS DOORS

.1 Supply access doors for furred ceilings or spaces for servicing equipment and accessories or for inspection of safety, operating, or fire devices for installation by the appropriate trade.

3.7 PAINTING REPAIRS AND RESTORATION

.1 Painting of equipment and material installed under Division 21, 22 and 23 is not part of the mechanical work except as noted.

.2 Do painting in accordance with Section 09 91 23 - Interior Painting.

.3 Prime and touch up marred finished paintwork to match original.

.4 Restore to new condition, finishes which have been damaged.

.5 Clean all uncoated metal surfaces such as piping, fittings, valves, and equipment and leave ready for painting.

- .6 Prime uncoated metal surfaces in areas exposed to view that will be inaccessible to painter after installation.
- .7 Assist painter to determine proper colour coding.

3.8 FIELD QUALITY CONTROL

- .1 Testing Piping Systems:
 - .1 Conduct tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
 - .2 Conduct tests and pay for all associated work including making good and re-testing when required.
 - .3 Notify Consultant 48 hours in advance of date when tests will be conducted.
 - .4 Make sure all work has been tested and approved prior to insulating or concealing.
 - .5 Carry out tests in the presence of the Consultant and the Authority having jurisdiction.
 - .6 Forward written test results to the Consultant.
 - .7 Leave all work uncovered until completion of testing. However, should the construction schedule require that work be covered, carry out tests on portions of system prior to system completion. Give a minimum of 48 hours notice to Consultant of such prior testing.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .3 Field Testing:
 - .1 If the field tests indicate that equipment supplied to the project does not meet specifications, laboratory certification of the potentially deficient equipment may be requested by the Owner. In the event that equipment does not meet specifications, the Contractor shall be responsible for the costs of the above laboratory tests, and all subsequent testing and correction required.

3.9 DEMONSTRATION

- .1 Consultant will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.

3.10 PROTECTION

- .1 Protect equipment and material during construction from the weather, moisture, dust, painting, plastering and physical damage. Cover all equipment with polyethylene plastic sheets during plaster

or concrete work and clean and return to "as new" condition prior to Substantial Performance of the Work. Provide for repainting of marked or damaged surfaces as required.

3.11 CLEAN-UP

- .1 At all times keep the premises free from accumulations of waste material or rubbish caused by employees or work, and at the completion of the work, remove all rubbish and all tools, equipment and surplus materials from and about the work and leave the work "broom clean" or its equivalent, unless more exactly specified.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .1 ANSI/ASHRAE/IESNA 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials (ASTM International)
- .1 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - .2 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449M, Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 533, Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C 547, Specification for Mineral Fiber Pipe Insulation.
 - .7 ASTM C 553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .8 ASTM C 612, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .9 ASTM C 795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .10 ASTM C 921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CGSB 51-GP-53M, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .4 Thermal Insulation Association of Canada (TIAC)
 - .1 National Insulation Standards.
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

1.3 PRODUCT DATA

- .1 Submit Product Data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 SAMPLES

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

- .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

1.5 MANUFACTURER'S INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with 01 33 00 - Submittal Procedures.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.6 QUALIFICATIONS

- .1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions recommended by manufacturer.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Refer to Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

PART 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre: includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24° C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code A-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: ASTM C 547.
 - .2 Maximum "k" factor: ASTM C 547.
- .4 TIAC Code A-3: Rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: ASTM C 547.
 - .2 Jacket: to CGSB 1-GP-52Ma.
 - .3 Maximum "k" factor: ASTM C 547.
- .5 TIAC Code C-1: Rigid mineral fibre board, unfaced.
 - .1 Mineral fibre: ASTM C 612.
 - .2 Maximum "k" factor: ASTM C 612.

- .6 TIAC Code C-4: Rigid mineral fibre board faced with factory applied vapour retarder jacket.
 - .1 Mineral fibre: ASTM C 612.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: ASTM C 612.
- .7 TIAC Code C-2: Mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: ASTM C 553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: ASTM C 553.
- .8 TIAC Code A.6: Flexible unicellular tubular elastomer.
 - .1 Insulation: with vapour retarder jacket.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor.
 - .4 Certified by manufacturer free of potential stress corrosion cracking corrodants.
- .9 TIAC Code A-2: Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
 - .1 Insulation: ASTM C 533.
 - .2 Maximum "k" factor: ASTM C 533.
 - .3 Design to permit periodic removal and re-installation.

2.3 CEMENT

- .1 Thermal insulating and finish
 - .1 To: ASTM C 449/C 449M.
 - .2 Air drying on mineral wool, to ASTM C 449.

2.4 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CGSB 51-GP-53M with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint.
 - .3 Minimum service temperatures: -20° C.
 - .4 Maximum service temperature: 65° C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .6 Special requirements:
 - .1 Outdoor: UV rated material at least 0.5 mm thick.
 - .7 Covering adhesive: Compatible with insulation.
- .2 ABS Plastic:
 - .1 One-piece moulded type and sheet with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint.
 - .3 Minimum service temperatures: -40 ° C.
 - .4 Maximum service temperature: 82 ° C.
 - .5 Moisture vapour transmission: 0.012 perm.
 - .6 Thickness: 0.75 mm.
 - .7 Fastenings:
 - .1 Solvent weld adhesive compatible with insulation to seal laps and joints
 - .8 Locations:
 - .1 For outdoor use ONLY.
- .3 Canvas:

- .1 120 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .2 Lagging adhesive: Compatible with insulation.
- .4 Aluminum:
 - .1 To ASTM B 209.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Smooth.
 - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- .5 Stainless steel:
 - .1 Type: 304.
 - .2 Thickness: 0.25 mm.
 - .3 Finish: Smooth.
 - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

2.5 INSULATION SECUREMENTS

- .1 Tape: Self-adhesive, aluminum, plain, 50 mm wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.
- .6 Facing: 25 mm galvanized steel hexagonal wire mesh on one face of insulation.
- .7 Fasteners: 2 mm diameter pins with 35 mm diameter clips. Length of pin to suit thickness of insulation.

2.6 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.7 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.8 OUTDOOR VAPOUR RETARDER MASTIC

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².

PART 3 EXECUTION

3.1 PRE- INSTALLATION REQUIREMENTS

- .1 Pressure testing of equipment and adjacent piping systems complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards
 - .1 Hot equipment: To TIAC code 1503-H.
 - .2 Cold equipment: to TIAC code 1503-C.
- .2 Elastomeric Insulation: to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.
- .3 Provide vapour retarder as recommended by manufacturer.
- .4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.
- .5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports outside vapour retarder jacket.
- .7 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: At expansion joints, valves, primary flow measuring elements, flanges and unions at equipment.
- .2 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

3.4 EQUIPMENT INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 In piping 1 in. or less, insulation is not required for strainers, control valves and balancing valves.
- .3 Hot Equipment:
 - .1 TIAC code A-1 or C-1 with mechanical fastenings or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
 - .2 TIAC code C-2 unfaced with bands and 13 mm cement precede by one layer of reinforcing mesh.
 - .3 Thicknesses:
 - .1 Heat exchangers 50 mm
 - .2 Air Separators 50 mm

- .4 Cold equipment:
 - .1 TIAC A-3 or C-4 with mechanical fastenings or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
 - .2 TIAC C-2 faced with vapour retardant jacket and with bands and 13 mm cement preceded by one layer of reinforcing mesh.
 - .3 TIAC A-6 or C-4 with mechanical fastenings or bands.
 - .4 Thicknesses:
 - .1 Air Separators 25 mm.
 - .2 Heat Exchangers 25 mm.
- .5 Finishes:
 - .1 Equipment in mechanical rooms: TIAC code CEF/1 with jacket.
 - .2 Equipment elsewhere: TIAC code CEF/2 with jacket.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Co-operate and co-ordinate with the requirements of other units of work specified in other sections.
- .2 This section covers the insulation of the following:
 - .1 Domestic hot, cold, and hot water recirculation piping
 - .2 Refrigerant Piping
 - .3 Storm drainage lines inside building (All Storm Drainage Lines shall be insulated as specified in this section for all piping Cast Iron, Copper and Plastic PVC Drainage piping. The insulation of PVC Piping shall be for sound attenuation.)
 - .4 Horizontal and concealed vertical rainwater leaders inside the building (All Storm Drainage Lines shall be insulated as specified in this section for all piping Cast Iron, Copper and Plastic PVC Drainage piping. The insulation of PVC Piping shall be for sound attenuation.)

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-2019, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B 209M, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].
 - .2 ASTM C 335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 533, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C 547, Mineral Fiber Pipe Insulation.
 - .7 ASTM C 795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C 921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

- .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit product data for the following:
 - .1 Aluminum/Canvas Coverings
 - .2 Piping Insulation Types, noting application for each product
 - .3 Finishing cement
 - .4 Lagging adhesive
 - .5 Lavatory Drain Insulation
 - .6 Pipe Coverings
 - .7 Piping Insulation Inserts
 - .8 PVC/ABS Jackets
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section and have at least 3 years successful experience in this size and type of project.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.

PART 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702.
 - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702.
- .5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/ULC-S702.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702.
- .6 TIAC Code A-6: flexible unicellular tubular elastomer.
 - .1 Insulation: with vapour retarder jacket.
 - .2 Jacket: to CGSB 51-GP-52Ma.

- .3 Maximum "k" factor: to CAN/ULC-S702.
- .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

- .7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
 - .1 Insulation: to ASTM C 533.
 - .2 Maximum "k" factor: to CAN/ULC-S702.
 - .3 Design to permit periodic removal and re-installation.

2.3 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Hydraulic setting or Air drying on mineral wool, to ASTM C 449/C 449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.8 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 Use PVC jackets only where surface temperature is between -20 degrees C and 65 degrees C only.
 - .2 One-piece moulded type to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .3 Colours: White
 - .4 Minimum service temperatures: -20 degrees C.
 - .5 Maximum service temperature: 65 degrees C.
 - .6 Moisture vapour transmission: 0.02 perm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .8 Special requirements:
 - .1 Outdoor: UV rated material at least 0.5mm thick.

- .2 Aluminum:
 - .1 To ASTM B 209.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: smooth, stucco embossed or corrugated.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- .3 Stainless steel:
 - .1 Type: 304.
 - .2 Thickness: 0.25 mm.
 - .3 Finish: smooth.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

- .1 Caulking to: Section 07 92 10 - Joint Sealing.

2.10 LAVATORY DRAIN INSULATION

- .1 Use McGuire ProWrap seamless lavatory insulation kits, manufactured of anti-microbial closed cell moulded vinyl material.
- .2 Insulate all lavatory drains shown on Drawings.
- .3 Standard of Acceptance: Truebro

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.

- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.
- .6 Provide insulation protection shields:
 - .1 Insulated cold piping (Fluid Operating Temperature Range <4 deg. C to 15 deg. C):
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
 - .2 Insulated hot piping Fluid Operating Temperature Range 20 deg. C to 175 deg. C):
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.
- .7 Fittings
 - .1 Insulate fittings with sections of the pipe covering mitred to fit tightly, or strips of flexible insulation, then apply reinforcing membrane embedded in barrier coating. Alternatively insulate fittings with tightly placed flexible insulation and apply PVC fitting covers.
- .8 Valves
 - .1 Insulate valve bodies, bonnets and strainers with insulating cement; or with fitted pipe coverings; or with mitred blocks all to thickness of adjacent pipe covering, then apply reinforcing membrane embedded in barrier coating. Alternatively, insulate with tightly placed flexible insulation covered with reinforcing membrane, stapled in place and covered with a barrier coating. Leave drains, blow-off plugs and caps uncovered.
- .9 Flanges
 - .1 Insulate cold flanges with oversized pipe covering or mitred blocks to the thickness of the adjacent pipe covering, then apply reinforcing membrane embedded in barrier coating.
- .10 Insulation Termination Points
 - .1 Terminate insulation 3" from fittings to provide working clearance and bevel insulation at 45° angle.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at expansion joints, valves, primary flow measuring elements and flanges and unions at equipment.
- .2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: aluminum, PVC or high temperature fabric.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 In piping 1 in. or less, insulation is not required for strainers, control valves and balancing valves.

- .3 TIAC Code: A-1.
 - .1 Securements: bands, Tape at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .4 TIAC Code: A-3.
 - .1 Securements: bands, Tape at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .5 TIAC Code: A-6.
 - .1 Insulation securements: Tape.
 - .2 Seals: lap seal adhesive, lagging adhesive.
- .6 TIAC Code: C-2 with vapour retarder jacket.
 - .1 Securements: bands, Tape at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .7 Thickness of insulation as listed in following table.
 - .1 Thicknesses listed below are based upon adherence to ASHRAE 90.1-2013.
 - .2 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .3 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

<u>Service</u>	<u>Operating Temperature (°F)</u>	<u>TIAC Code</u>	<u>Pipe Diameter</u>	<u>Insulation Thickness</u>
Domestic Cold Water, and Above Ground Storm Water & Vertical Rainwater leaders (Anti-Sweat)		A-3 or C-2	1 1/4" and under	13 mm (1/2")
			1 1/2" and over	25 mm (1")
Domestic Hot Water and Hot Water Recirculation	<140 °F	A-3	1 1/4" and under	25 mm (1")
			1 1/2" and over	38 mm (1 1/2")
Refrigeration Lines	<40 °F to 60 °F	A-6	<1"	13 mm (1/2")
			1" and over	25 mm (1")

- .8 Finishes:
 - .1 Exposed indoors: PVC jacket.
 - .2 Exposed in mechanical rooms: PVC jacket.
 - .3 Concealed, indoors: insulation on concealed piping will be left as factory finished with no further finish required.
 - .4 Outdoors: water-proof aluminum jacket.
 - .5 Finish attachments: Seals: closed.
 - .6 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 FIELD QUALITY CONTROL

- .1 Use only licensed journeymen for the work.
- .2 Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations.
- .3 Carry out insulation work only after the following conditions have been met:
 - .1 Required tests have been completed;
 - .2 Surfaces to be covered are clean and dry;
 - .3 Ferrous surfaces have been painted.
- .4 Use only clean and dry insulation for the work.
- .5 Install insulation with smooth and even surfaces, with round shapes laid to true circular and concentric shape, shape to blend with fitting insulation and adjacent covering; with full length section and tight to insulated object.
- .6 Supports:
 - .1 Do not penetrate vapour seals with pipe hangers and supports.
 - .2 Vertical pipe over 80mm: use insulation supports welded or bolted to pipe directly above lowest pipe fitting, thereafter locate on 4600mm centres and at each valve or pair of line flanges.
 - .3 Space insulation and support for movement of piping as required.
- .7 Penetrations:
 - .1 For covered or uncovered pipes, pack mineral fibre insulation solidly around pipes where they pass through sleeves, for depth of penetration. Those with vapour barrier jacket shall have continuous covering. Make sure that pipe sleeves accommodate full thickness of insulation and allow pipe expansion. Provide mastic topping to seal annular space.
- .8 Butt Joints:
 - .1 Adhere and seal laps of vapour barrier cover or use 100 mm wide vapour barrier strip using vapour seal adhesive.
 - .2 Stagger both longitudinal and horizontal joints on duct insulation in multi-layered construction.
 - .3 At each end of unions and flanges on low pressure systems, at pipe hangers, and at other points where required, terminate insulation with insulation cement trowelled on bevel.
- .9 Allow for radial expansion of pipe and permit pipe to move longitudinally inside insulation and to expand and contract without opening up joints between sections.
- .10 Gouge out insulation for proper fit where there is interference between weld bead and insulation. Bevel insulation away from studs and nuts to permit their removal without damage to insulation. Closely and neatly trim insulation around extending parts of pipe saddles, supports, hangers, and clamp guides and seal with insulating cement.
- .11 For all locations where pipe hangers are on the outside of the insulation, provide insulation saddles or blocks of high density insulation to prevent crushing or compression of insulation due to weight of pipe. See Item 3.3.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.

- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, garbage, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
- .1 Materials and installation for wet pipe fire protection and sprinkler systems.
- .2 Materials and installation for dry pipe fire protection and sprinkler systems.

1.2 RELATED SECTIONS

- .1 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Section 21 05 01 – Common Work Results for Mechanical
- .3 Section 21 05 05 – Common Work Results for Fire Suppression Systems
- .4 Section 21 30 00 – Fire Pumps
- .5 Section 28 31 00 – Fire Detection and Alarm
- .6 Section 23 05 05 - Installation of Pipework.

1.3 REFERENCES

- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)
 - .1 ANSI/NFPA 13, Installation of Sprinkler Systems.
 - .2 ANSI/NFPA 20, Standard for the Installation of Stationary Fire Protection.
 - .3 ANSI/NFPA 24, Installation of Private Fire Service Mains and Their Appurtenances.
 - .4 ANSI/NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN4 S543-[M984], Standard for Internal Lug Quick Connect Couplings for Fire Hose.
- .3 Applicable standards (conform to current requirements of):
 - .1 Ontario Building Code
 - .2 Ontario Fire Code
 - .3 National Building Code
 - .4 National Plumbing Code
 - .5 National Fire Code
 - .6 Insurers' Advisory Organization of Canada (IAO)
 - .7 Sprinkler Systems, Canadian Industrial Risks Insurers (CIRI), Interpretive Guide.
 - .8

1.4 SAMPLES

- .1 Submit samples of following:
 - .1 Each type of sprinkler head.
 - .2 Signs.

1.5 DESIGN REQUIREMENTS

- .1 Design of the automatic wet pipe fire suppression sprinkler systems associated with this project is in accordance with required and advisory provisions of NFPA 13, by hydraulic calculations for uniform distribution of water over design area. Occupancy hazard shall be as required by NFPA 13. These specifications for the sprinkler fire protection systems are "Performance" specifications and are intended to establish design criteria and basic guidelines for the work. This contractor shall assume full responsibility for the layout and details of all fire protection work to meet the requirements of all applicable standards, local governing codes and regulations, to the approval of the Ontario Fire Marshall, and the Owner's insurance underwriter.
- .2 Automatic sprinkler systems to be provided by:
 - .1 Qualified and recognized automatic sprinkler installation firm with an established reputation, regularly engaged in this field, and who is a member of Canadian Automatic Sprinkler Association (CASA).
 - .2 All personnel employed on site for automatic sprinkler system installation, to be in possession of valid Canadian Automatic Sprinkler Association Certificate of Qualification and "Registered Sprinkler and Fire Protection Installer" identification card.
- .3 Refer to sprinkler zoning drawings for sprinkler zones and sprinkler piping routing and riser locations.
- .4 Refer to Architectural Ceiling Plans for details on bulkheads, suspended ceilings that will require additional sprinkler heads above and below.
- .5 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.
- .6 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.
- .7 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.
- .8 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.
- .9 Location of Sprinkler Heads:
 - .1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13.
 - .2 Uniformly space sprinklers on branch.
- .10 Water Distribution:
 - .1 Make distribution uniform throughout the area in which sprinkler heads will open.
 - .2 Discharge from individual heads in hydraulically most remote area to be 100% of specified density required in NFPA 13.
- .11 Density of Application of Water:
 - .1 Size pipe to provide specified density when system is discharging specified total maximum required flow.
 - .2 Application to horizontal surfaces below sprinklers shall be lpm per m² as required for NFPA 13.
- .12 Sprinkler Discharge Area:
 - .1 Area: hydraulically most remote m² area as defined in NFPA 13.

- .13 Outside Hose Allowances:
 - .1 Include allowance in hydraulic calculations of lpm for outside hose streams per NFPA.
- .14 Friction Losses:
 - .1 Calculate losses in piping in accordance with Hazen-Williams formula with 'C' value of 120 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping.
- .15 Water Supply:
 - .1 Conduct flow and pressure test of water supply in vicinity of project to obtain criteria for basis of design in accordance with ANSI/NFPA 13 if required.
- .16 Show the following in the drawings submitted to the Owner's Representative for approval.
 - .1 Show the layout and size of all piping and equipment from the point of connection to the water supply, to the sprinkler cross mains. The contract drawings must include a detailed sprinkler riser diagram. Water velocity in the piping should not exceed 6 m/s (20 ft/s).
 - .2 Show location and size of service mains, interior feed mains, control valves, sprinkler risers, drain lines, sectional valves and inspector's test valves and switches on the drawings.
 - .3 Specify waterflow data including hydrant flow results, including location where the hydrant flow test was conducted, the location and size of existing mains and new water supply lines that will serve the sprinkler system (including all supervisory valves), and the location and size of all risers.
 - .4 Highlight or clearly indicate the area(s) to be protected by sprinklers on the drawings.
 - .5 Specify waterflow requirements including the design density, design area, the hose stream demand (including location of the hose stream demand), the duration of supply, and sprinkler spacing and area of coverage in this section.
 - .6 Show the location of the backflow preventer (including provisions for a drain and access for maintenance) where the potable water supply system is at risk of contamination by the sprinkler system on the drawings.
 - .7 Show all provisions necessary for forward flow testing of the backflow preventer at system demand, as required by NFPA 13 on the drawings. Indicate location of all components and required items, including test ports, for pressure measurements both upstream and downstream of the backflow preventer, a drain to the building exterior, and appropriate permanent means of disposing of the large quantity of water that will be involved in the initial test and subsequent annual tests.
 - .8 Highlight all concealed spaces on the drawings that require sprinkler protection, such as spaces above suspended ceilings that are built of combustible material or that can contain combustible materials, such as storage, and communication cabling that is not fire-rated.

1.6 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Indicate:
 - .1 Materials.
 - .2 Finishes.
 - .3 Method of anchorage
 - .4 Number of anchors.
 - .5 Supports.
 - .6 Reinforcement.

- .7 Assembly details.
 - .8 Accessories.
 - .3 Prepare shop drawings with hydraulic calculations immediately after the award of the contract, and forward three copies to:
 - .1 Owner's insurance agents/brokers
 - .2 Insurers' Advisory Organization of Canadafor review and acceptance by Consultant. Note that changes made to sprinkler layout resulting in changes to sprinkler head locations and consequential number of sprinkler heads shall not result in change of contract price.
 - .4 Prepare revised shop drawings with hydraulic calculations based on the above review, and forward three copies to Reviewing Authority.
 - .5 Submit shop drawings stamped by the reviewing Authority to Consultant for approval.
 - .6 Submit CASA Certificate of Qualification and Sprinkler Fitter Identification Card for each sprinkler installer to be employed on project site, as part of shop drawing submittal.
 - .7 To avoid interference and clear all obstructions, any piping layouts shall be coordinated in the field with contractors of other trades, prior to the submission of shop drawings for approval at no additional cost.
 - .8 Materials shall not be ordered nor shall any work be installed until all the approvals have been obtained.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Test reports:
 - .1 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.
 - .2 Manufacturer's Field Reports: manufacturer's field reports specified.
- .4 Closeout Submittals:
 - .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with ANSI/NFPA 20.
 - .2 Manufacturer's Catalog Data, including specific model, type, and size for:
 - .1 Pipe and fittings.
 - .2 Alarm valves.
 - .3 Valves, including gate, check, and globe.
 - .4 Water motor alarms.
 - .5 Sprinkler heads.
 - .6 Pipe hangers and supports.
 - .7 Pressure or flow switch.
 - .8 Fire department connections.
 - .9 Excess pressure pump.
 - .10 Mechanical couplings.
 - .3 Drawings:
 - .1 Sprinkler heads and piping system layout.
 - .1 Prepare 36" by 48" detail working drawings of system layout in accordance with NFPA 13, "Working Drawings (Plans)".
 - .2 Show data essential for proper installation of each system.
 - .3 Show details, plan view, elevations, and sections of systems supply and piping.
 - .4 Show piping schematic of systems supply, devices, valves, pipe, and

- fittings. Show point to point electrical wiring diagrams.
- .2 Electrical wiring diagrams.
- .4 Design Data:
 - .1 Calculations of sprinkler system design.
 - .2 Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.
- .5 Field Test Reports:
 - .1 Preliminary tests on piping system.
- .6 Records:
 - .1 As-built drawings of each system.
 - .1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.
 - .2 Submit 36" by 48" drawings on reproducible Mylar film with title block similar to full size contract drawings.
- .7 Operation and Maintenance Manuals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Provide detailed hydraulic calculations including summary sheet, and Material and Test Certificate for aboveground and underground piping and other documentation for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with ANSI/NFPA 13.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Qualified and recognized automatic sprinkler installation firm with an established reputation, regularly engaged in this field, and who is a member of Canadian Automatic Sprinkler Association (CASA).
 - .2 All personnel employed on site for automatic sprinkler system installation, to be in possession of valid Canadian Automatic Sprinkler Association Certificate of Qualification and "Registered Sprinkler and Fire Protection Installer" identification card.

1.8 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Provide spare sprinklers and tools as required by ANSI/NFPA 13.

1.9 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .2 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .3 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Storage and Protection:
 - .1 Store materials indoors.
 - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Refer to Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Pipe for incoming service, sprinkler header, siamese incoming service, sprinkler fire pump piping, and sprinkler riser from base to top of vertical: up to 1200 kPa (175 psi).
- .2 Pipe:
 - .1 All: Schedule 10 and/or 40 seamless or ERW steel to ASTM A53, A135, or A795, Grade B and NFPA 13.
 - .2 All ASTM A795 pipe to be hydrostatically tested.
- .3 Joints:
 - .1 Flanged, welded, or grooved coupling.
- .4 Fittings:
 - .1 Forged steel, butt welding Schedule 40 for NPS 2 1/2 and over.
- .5 Flanges:
 - .1 1035 kPa (150 lb) forged steel, slip-on, raised face style.
 - .2 1035 kPa (150 lb) forged steel, weld neck, raised face style.
- .6 Flange gaskets:
 - .1 Buna-N, Neoprene, or EPDM sheet, 1.6 mm (1/16 in) thick.
- .7 For grooved couplings, see 2.5 using Schedule 40 seamless or ERW steel pipe to ASTM A53, A135, or A795, Grade B, and Victaulic Zero-Flex couplings. All ASTM A795 pipe to be hydrostatically tested.
- .8 Pipe hangers:
 - .1 ULC listed for fire protection as specified in Section 23 05 29 - Pipe Hangers and Supports.

2.2 ABOVE GROUND PIPING SYSTEMS

- .1 Provide fittings for changes in direction of piping and for connections.
 - .1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.

2.3 PIPE AND FITTINGS

- .1 Pipe:
 - .1 Ferrous: to ANSI/NFPA 13.
 - .2 Copper tube: to ANSI/NFPA 13.
- .2 Fittings and joints to ANSI/NFPA 13:
 - .1 Ferrous: screwed, welded, flanged or roll grooved.
 - .2 Copper tube: screwed, soldered, brazed.
 - .3 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will be permitted.
 - .4 Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.
 - .5 Fittings: ULC approved for use in wet pipe sprinkler systems.
 - .6 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.

- .7 Sprinkler pipe and fittings: metal.
- .3 Pipe and fittings: threaded; up to 1200 kPa (175 psi).
 - .1 Pipe:
 - .1 Up to NPS 2: Schedule 40 seamless or ERW steel to ASTM A53, A135, or A795, Grade B.
 - .2 All ASTM A795 pipe to be hydrostatically tested.
 - .2 Joints:
 - .1 Threaded up to NPS 2.
 - .3 Fittings:
 - .1 1035 kPa (150 lb) black malleable iron threaded up to NPS 2.
 - .4 Unions:
 - .1 1035 kPa (150 lb) black malleable iron, bronze face ground joint up to NPS 2.
 - .5 Pipe hangers:
 - .1 ULC listed for fire protection as specified in Section 23 05 29 - Pipe Hangers and Supports.
- .4 Pipe and fittings: flanged or welded; up to 1200 kPa (175 psi).
 - .1 Pipe:
 - .1 Up to NPS 2: Schedule 40 seamless or ERW steel to ASTM A53, A135, or A795, Grade B.
 - .2 NPS 2 1/2 and over: Schedule 40 seamless or ERW steel to ASTM A53, A135, or A795, Grade B.
 - .3 All ASTM A795 pipe to be hydrostatically tested.
 - .2 Joints:
 - .1 Welded or flanged, for NPS 2 1/2 and over.
 - .3 Fittings:
 - .1 Forged steel butt weld, Schedule 40 for NPS 2 1/2 and over.
 - .4 Flanges:
 - .1 1035 kPa (150 lb) forged steel, slip-on, raised face style.
 - .2 1035 kPa (150 lb) forged steel, weld neck, raised face style.
 - .5 Flange gaskets:
 - .1 Buna-N, neoprene, or EPDM, sheet 1.6 mm (1/16 in) thick.
 - .6 Pipe hangers:
 - .1 ULC listed for fire protection as specified in Section 23 05 29 - Pipe Hangers and Supports.
- .5 Pipe and fittings to 1200 kPa (175 psi) – grooved coupling method.
 - .1 Pipe:
 - .1 Up to NPS 2: Schedule 10 or Schedule 40 seamless or ERW steel to ASTM A53, A135, or A795, Grade B, with rolled grooves.
 - .2 NPS 2 1/2 to NPS 12: Schedule 10 or Schedule 40 seamless or ERW steel to ASTM A53, A135, or A795, Grade B, with rolled grooves.
 - .3 NPS 14 and over: 0.375 in wall thickness ERW steel to ASTM A53 or A135, Grade B, with rolled grooves.
 - .4 All ASTM A795 pipe to be hydrostatically tested.
 - .2 Couplings, fittings and flanges:
 - .1 Couplings:
 - .1 Malleable or ductile iron NPS 2 1/2 and over.
 - .2 Fittings
 - .1 Malleable iron or ductile iron
 - .2 Fabricated steel NPS 14 and
 - .3 Flanges
 - .1 Cast iron, raised face flange
 - .4 Gaskets

- .1 EPDM Grade "E" for grooved

Standard of Acceptance:

- Victaulic
- Gruvlock

- .6 Pipe hangers

- .1 ULC listed for fire protection as specified in Section 23 05 29 - Pipe Hangers and Supports.

2.4 VALVES

- .1 Valves:

- .1 ULC listed for fire protection service.
.2 Gate valves: open by counterclockwise rotation.
.3 Provide rising stem valve beneath each alarm valve in each riser when more than one alarm valve is supplied from same water supply pipe.
.4 Check valves: flanged clear opening swing-check type with flanged inspection and access cover plate for sizes 10 cm and larger.
.5 Provide gate valve in piping protecting elevator hoistways, machine rooms, and machinery spaces.

- .2 ULC and FM listed for fire protection service.

- .1 Gate valves up to NPS 2 threaded:

- .1 1200 kPa (175 lb) CWP, bronze, solid wedge, OS & Y rising stem, up to NPS 2.

Standard of Acceptance:

- Crane 459
- Jenkins 820J
- Nibco T-104-0

- .2 Gate valves NPS 2 1/2 and over, flanged:

- .1 1200 kPa (175 lb) CWP, IBBM flanged, OS & Y rising stem, solid wedge.

Standard of Acceptance:

- Nibco F-607-OTS or RW
- MAS W 10-A-RS-FF-B-HW

- .3 Butterfly valves NPS 2.

- .1 1200 kPa (175 lb) CWP, threaded or Ductile iron body grooved coupling ends, aluminum bronze or nickel plated ductile iron disc, EPDM seat, "OPEN/SHUT" indicator, externally mounted monitor switch.

Standard of Acceptance:

- Milwaukee "Butterball" Series BB-SCS
- Victaulic Series 727 Fireball
- MASW50AEDGGSGOA (grooved)
- MASW50DEDFNNGOA (NPT)

- .4 Butterfly valves NPS 2 1/2 and over.

- .1 1200 kPa (175 lb) CWP, tapped lug style Ductile or cast iron body, aluminum bronze or nickel plated ductile iron disc, EPDM seat, "OPEN/SHUT" indicator, externally mounted monitor switch.

Standard of Acceptance:

- MASW50AEDLLSGOA
- Grinnell Series 8000FP

- .5 Butterfly valves NPS 2 1/2 and over for grooved coupling.

- .1 1200 kPa (175 lb) CWP, "OPEN/SHUT" indicator, externally mounted monitor switch.

Standard of Acceptance:

- MAS W50AEDGGSGOA
- Victaulic Series 708-W or 727 FireBall

- GSP Series BV-G
- .6 Non-return valves, NPS 2 1/2 and over
 - .1 1200 kPa (175 lb) CWP, IBBM flanged, swing check, replaceable bronze disc and seat ring, bolted cover, NPS 2 1/2 and over.
Standard of Acceptance:
 - MAS W30ARDFF
 - Crane 375
 - Jenkins 477
 - National Fire Equipment A104G
 - Victaulic Series 717 Firelock
 - .2 Same as above but with rubber faced disc at Siamese connection.
Standard of Acceptance:
 - MASW30AEP.NPFF-F
 - Crane 375
 - Jenkins 477J
 - National Fire Equipment A104G
- .7 Automatic ball drip.
 - .1 720 kPa (250 psi) working pressure.
 - .2 NPS 1/2 or 3/4.
 - .3 Automatic seal under pressure.
Standard of Acceptance:
 - National Fire Equipment A58

2.5 SPRINKLER HEADS

- .1 General: to ANSI/NFPA 13 and ULC listed for fire services.
- .2 ULC and FM listed for fire service.
- .3 All sprinkler heads on project to be of same manufacture.
- .4 Sprinkler to be closed by pip and Belleville washer. O-ring sprinklers are not acceptable.
- .5 Guards and cages to suit locations (Refer to drawing M510).
- .6 Standard temperature rating 57°C to 74°C (135°F to 165°F).
- .7 Intermediate and high temperature rating heads to suit local conditions.
- .8 Sprinkler heads to be in accordance with the following:
 - .1 Upright, bronze body, glass bulb type.
 - .2 Concealed, flush mount with fusible white cover plate.
 - .3 Side wall, concealed, flush mount with fusible white cover plate.
- .9 Standard of Acceptance:
 - Viking
 - Grinnell
 - Star
 - Reliable
 - GEM
 - Victaulic

2.6 ALARM CHECK VALVE

- .1 Alarm check valve to ANSI/NFPA 13 and ULC listed for fire service.

- .2 Generally of same manufacture as specified for sprinkler heads.
- .3 Resilient seat swing check valve.
- .4 Fitted with OS & Y gate valves or butterfly valves, flow and pressure switches, test connections, drain connections and pressure gauges.

Standard of Acceptance:

- Viking
- Grinnell
- Star
- Reliable
- GEM
- Victaulic

2.7 WATER MOTOR ALARMS

- .1 Provide alarms approved weatherproof and guarded type, to sound locally on flow of water in each corresponding sprinkler system.
- .2 Mount alarms on outside of outer walls of each building at location as directed.
- .3 Provide separate drain piping directly to exterior of building.

2.8 SUPERVISORY SWITCHES

- .1 General: to ANSI/NFPA 13 and ULC listed for fire service.
- .2 With normally open and normally closed contacts and supervisory capability.
- .3 Provide switch with circuit opener or closer for automatic transmittal of alarm over facility fire alarm system.
- .4 Connect into building fire alarm system.
- .5 Connection of switch: Section 28 31 00 - Fire Alarm Systems.
- .6 ULC and FM listed for fire service.
- .7 Housing secured with tamperproof screws.
- .8 Mechanically secured, with two SPDT (form C) contacts and supervisory capability.
- .9 For OS & Y gate valves
 - Standard of Acceptance:*
 - Potter Electric Signal - Model OSYS-UA2 to suit valve size. contacts).
 - System Sensor - Model OSY2A
- .10 For post indicator and butterfly valves
 - Standard of Acceptance:*
 - Potter Electric Signal - Model PIVS-UA2
 - System Sensor - Model PIV2A
- .11 For valves installed in pits
 - .1 One SPDT (form C) contact.
 - .2 Only to be used if approved by Authority having jurisdiction.
 - Standard of Acceptance:*

- Potter Electric Signal - Model PMS-O (sealed, weatherproof).
- System Sensor - Model PSP1A

2.9 PRESSURE SWITCHES

- .1 Pressure switches on alarm check valves.
 - .1 ULC and FM listed for fire service.
 - .2 Service pressure rating of 1200 kPa (175 psi).
 - .3 1/2 in NPT male pressure connection.
 - .4 Housing secured with tamperproof screws.
 - .5 For loss of normal water pressure on wet pipe sprinkler system.
 - .1 Operation on pressure decrease of 200 kPa (30 psi).
 - .2 One SPDT (Form C) contacts, 10 Amp at 125/250 VAC.

Standard of Acceptance:

 - Potter Electric Signal - Model PSS-120
 - System Sensor - Model EPSA120-1
- .6 For providing alarm condition on wet pipe sprinkler system.
 - .1 Operation on pressure change of 30-60 kPa (4-8 psi).
 - .2 One or two SPDT (Form C) contacts, 10 Amp at 125/250 VAC.

Standard of Acceptance:

 - Potter Electric Signal - Model PS10-1 or -2
 - System Sensor - Model EPSA10-1 or -2

2.10 FLOW SWITCHES

- .1 Flow switches.
 - .1 ULC and FM listed for fire service.
 - .2 For mounting in zone piping

Standard of Acceptance:

 - Grinnell Company of Canada - Model F-620
 - Potter Electric Signal - Model VSR-D
 - System Sensor - Model WFD--A series

2.11 WATER GONG

- .1 To ANSI/NFPA 13 and ULC listed for fire service. Location as indicated.
- .2 Water operated outside alarm bell, weather protected.

2.12 ALARM TEST MODULE

- .1 ULC and FM listed for fire service.
- .2 Orifice to suit single sprinkler flow.
- .3 Locate as per NFPA 13 requirements.
- .4 Threaded connections.

Standard of Acceptance:

 - Victaulic, Style 718 TestMaster or Style 720 TestMaster II, with threaded ends
 - AGF "TesTanDrain"
 - Grinnell model F350
 - G/J "Sure-Test"

2.13 PRESSURE GAUGES

- .1 Maximum limit of not less than twice normal working pressure at point where installed.

2.14 PIPE SLEEVES

- .1 Provide pipe sleeves where piping passes through walls, floors, and roofs.
- .2 Secure sleeves in position and location during construction.
- .3 Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs.
- .4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.
 - .1 Firmly pack space with mineral wool insulation.
 - .2 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass, provide mechanically adjustable segmented elastomeric seal.
 - .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.
- .5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide hot-dip galvanized steel, cast-iron sleeves.
 - .2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.
- .6 Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide 0.61 mm thick galvanized steel sheet.

2.15 ESCUTCHEON PLATES

- .1 Provide one piece or split hinge type metal plates for piping passing through walls, floors and ceilings in exposed spaces.
- .2 Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces.
- .3 Provide paint finish on metal plates in unfinished spaces.

2.16 INSPECTOR'S TEST CONNECTION

- .1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.
- .2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.
- .3 Provide discharge orifice of same size as corresponding sprinkler orifice.

2.17 SIGNS

- .1 Attach properly lettered and approved metal signs to each control valve, shut-off valves, drain valves, test valves and alarm device to ANSI/NFPA 13.
- .2 Permanently fix hydraulic design data nameplates to riser of each system.

- .3 150 mm x 150 mm (6 in x 6 in) for automatic control valves and alarm valves.
- .4 50 mm x 150 mm (2 in x 6 in) for other valves.
- .5 Made of enamelled steel with fire department red enamel background, white lettering, inscription in accordance with NFPA FM Standards.
- .6 Made of lamicoid plate, red background with white lettering, where enamelled steel is not required.

2.18 SPRINKLER CONTROL CABINETS

- .1 765 mm (30 in) high, 765 mm (30 in) wide and 305 mm (12 in) deep, flush type with 1.6 mm (16 ga) steel tub, 2.5 mm (12 ga) metal door, and 2.5 mm (12 ga) flush adjustable plaster trim with full rebate for door.
- .2 Fully concealed, 180E opening door hinges and corbin latch with lock of flush cast construction.
- .3 Without bolts and/or screws on face of cabinet.
- .4 Interior surfaces of cabinet prime painted with final finish provided under Finishes, Division 9.
- .5 Flanged OS & Y gate valve, or butterfly valve, drain and test equipment as shown.
- .6 Identified by red lettered sign "X FLOOR, Y ZONE SPRINKLER SHUT-OFF VALVE. DRAIN AND TEST".
- .7 Fitted with alarm test module.

2.19 ANTIFREEZE

- .1 Antifreeze loops to ANSI/NFPA 13, locations as indicated.

2.20 SPARE PARTS CABINET

- .1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA 13. Include at least one head of each type and temperature rating installed in system.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install, inspect and test to acceptance in accordance with ANSI/NFPA 13 and ANSI/NFPA 25.

3.3 WATER SERVICE

- .1 Obtain existing sprinkler drawings from Contractor for existing incoming water size and details.

3.4 PIPE INSTALLATION

- .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
- .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
- .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.
- .4 Inspect piping before placing into position.

3.5 SPRINKLER INSTALLATION

- .1 Provide headers, alarm check valve assemblies and fire department connections as shown.
- .2 Valves as shown to be fitted with supervisory switches. Wiring from supervised valves and provision of supervisory annunciator will be done under Electrical Division 28.
- .3 Provide signs at each valve identifying portion of system controlled. Fasten signs to pipe in immediate vicinity of valve.
- .4 Extend piping through zone sprinkler control cabinets and connect to sprinklers.
- .5 Wiring of trouble and flow alarms from zone sprinkler control cabinets and alarm check valves will be done under Electrical Division 28.
- .6 Provide drain valves at trapped low points in piping system. Coordinate rigid piped connections with air gap to dedicated drains with general contractor and plumbing contractor prior to plumbing rough-ins being concealed. The use of floor drains or janitor sinks as drainage points will not be permitted.
- .7 Use concealed type sprinklers where suspended ceilings occur. Locate sprinklers in symmetrical pattern to suit reflected ceiling plans and to avoid speakers, fire alarm components, lighting fixtures, ductwork and diffusers. In general, centre heads in ceiling tiles, mount in line with lights and add extra rows to meet these requirements.
- .8 Sprinklers in exposed areas without ceilings shall be upright type with bronze finish.
- .9 Sprinklers located in ceilings and as listed on the drawings shall be concealed type.
- .10 Provide additional sprinkler heads with associated piping for sprinkler protection under ducts, under obstructions, and in blind spaces. Include these sprinkler heads in hydraulic calculations.
- .11 Run 2 NPS drain through wall to outside for full water flow testing as required.
- .12 Coordinate the installation of all fire protection systems with the work of all other trades. Provide all necessary offsets in piping to avoid interference with other equipment and systems and provide additional sprinkler heads due to offsets and/or interference as required to achieve design coverage at no additional cost.
- .13 All horizontal piping shall be installed as high above finished floor as possible with due allowance for clearances for sprinklers as required by NFPA 13.

- .14 All drains and test connections shall be discharged into the building drainage system through an approved indirect waste connection or shall be piped to discharge to the building exterior. The contractor shall provide precast concrete splash blocks at all drains and test connections discharging to the building exterior at unpaved points.
- .15 All piping shall be concealed above ceiling in all areas. Drains and/or test connections shall not be terminated exposed in finished rooms.
- .16 All piping through interior walls and partitions shall be sleeved and closed off with escutcheons where visible.

3.6 FIELD QUALITY CONTROL

- .1 Site Test, Inspection:
 - .1 Perform test to determine compliance with specified requirements in presence of Engineer.
 - .2 Test, inspect, and approve piping before covering or concealing.
 - .3 Preliminary Tests:
 - .1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.
 - .2 Flush piping with potable water in accordance with NFPA 13.
 - .3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.
 - .4 Test alarms and other devices.
 - .5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with NFPA 13.
 - .4 Formal Tests and Inspections:
 - .1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.
 - .2 Test sprinkler systems in accordance with requirements of latest edition of NFPA 13.
 - .3 Submit written request for formal inspection at least 10 days prior to inspection date to following authorities
 - Local Fire Department.
 - Insurer's Representative.
 - Owner's Personnel.
 - Engineer.
 - Consultant.
 - General Contractor or Management Consultant responsible for construction of project.
 - .4 Repeat required tests as directed.
 - .5 Correct defects and make additional tests until systems comply with contract requirements.
 - .6 Furnish appliances, equipment, instruments, connecting devices, and personnel for tests.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

- .3 Obtain Contractor's Material and Test Certificate for underground piping.
- .4 Obtain Contractor's Material and Test Certificate for above ground piping.
- .5 On completion of project obtain Certificate of Approval showing that work is in accordance with rules and regulations of National Fire Protection Association.
- .6 Copies of Certificates to be distributed as per shop drawing requirements.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY ACTION INCLUDES:

- .1 Materials and installation for plumbing pumps including:
 - .1 Domestic Hot Water Recirculation Pumps.
 - .2 Sump Pumps

1.2 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 45 00 – Quality Control
- .3 Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .4 Section 01 78 00 – Closeout Submittals.
- .5 Section 01 91 13 – General Commissioning (Cx) Requirements

1.3 REFERENCES

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).
 - .1 Standard 90.1-2019 Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.
- .3 Shop Drawings.
 - .1 Submit shop drawings to indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.
 - .2 Wiring and schematic diagrams.
 - .3 Dimensions and recommended installation.
 - .4 Pump performance and efficiency curves.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturers' Field Reports: manufacturers' field reports specified.
- .7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:
 - .1 Manufacturers name, type, model year, capacity and serial number.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list with names and addresses.

1.5 QUALITY ASSURANCE

- .1 Manufacturer's Certification: The Pumps manufacturer shall certify the following:
 - .1 The products and systems furnished are in strict compliance with the specifications.
 - .2 CSA certification.
 - .3 Comply with the energy requirements of the latest edition of ASHREA 90.1.
 - .4 The specified factory tests have been performed.
 - .5 The equipment furnished contains inter-changeable parts with specified equipment so that all major equipment parts can be obtained from the specified manufacturer.
- .2 Contractor Certification: The Contractor shall certify the following:
 - .1 The products and systems installed are in strict compliance with the specifications and all applicable local or provincial codes.
 - .2 The specified field tests have been satisfactorily performed.
 - .3 The equipment furnished contains inter-changeable parts with specified equipment so that all major equipment parts can be obtained from the specified manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

PART 2 PRODUCTS

2.1 DOMESTIC HOT WATER CIRCULATING PUMPS

- .1 Capacity: see pump schedule.
- .2 Construction: closed-coupled, in-line centrifugal, stainless steel casing, stainless steel seal face plate, aluminum motor housing, stainless steel shaft, stainless steel shaft sleeve, two permanently lubricated ball bearings.
- .3 Components:
 - .1 The pumps shall be a wet rotor inline pump, in cast iron or lead free bronze body construction specifically designed for quiet operation. Suitable standard operations at 230° F and 175 PSIG working pressure. The pump internals shall be capable of being serviced without disturbing piping connections.
 - .2 The pump internals shall be capable of being serviced without disturbing piping connections.
 - .3 Pump shall be equipped with a water-tight seal to prevent leakage.
 - .4 Pump volute shall be of lead free bronze for domestic water systems. The connection style on bronze pumps shall be flanged.
 - .5 Motor shall be a synchronous, permanent-magnet (PM) motor and tested with the pump as one unit. Conventional induction motors will not be acceptable.
 - .6 Each motor shall have an Integrated Variable Frequency Drive tested as one unit by the manufacturer.
 - .7 Integrated motor protection shall be verified by UL to protect the pump against over/under voltage, over temperature of motor and/or electronics, over current, locked rotor and dry run (no load condition).
 - .8 Pump shall have BACnet connections built into the VFD as standard options.
 - .9 Analog inputs, such as 0-10V and 4-20mA, are standard inputs built into the VFD.
 - .10 Pumps shall be UL 778 listed and bear the UL Listed Mark for USA and Canada with on-board thermal overload protection.

- .11 Pumps shall be UL 778 listed and bear the UL Listing Mark for USA and Canada with on-board thermal overload protection.
- .12 Each pump shall be factory performance tested before shipment
- .4 Supports: provide as recommended by manufacturer.
- .5 Acceptable Product: Taco, ITT, Bell & Gosset, Armstrong, Grundfoss, Wilo, Xylem.

2.2 ELEVATOR SUMP PUMPS

- .1 Capacity: see pump schedule.
- .2 Construction:
 - .1 Submersible centrifugal hermetically sealed pump with cast iron volute casing and oil filled motor chamber, non-clog cast iron impeller, stainless steel shaft, and ceramic carbon seals. Use stainless steel fasteners.
 - .2 Plastic components will not be accepted for housing, switch case, base, impeller or other external parts.
- .3 Motor: as indicated, hermetically sealed, with automatic overload protection.
- .4 Control Panel:
 - .1 Automatic pump control panel in Eemac 1 enclosure for indoor mounting, vandalproof, CSA approved with the following features:
 - .1 Pump disconnect circuit breaker
 - .2 Pump run light
 - .3 H-O-A selector switch
 - .4 High level alarm light and bell
 - .5 Contacts for remote high level alarm
- .5 Float Switches:
 - .1 Internally mechanically activated type with internal weight, support bracket with strain relief connectors, and PVC junction box for remote panel.
- .6 Standard of Acceptance: Zoeller, Barnes, Myers.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 INSTALLATION - DOMESTIC HOT WATER RECIRCULATION PUMPS

- .1 Install equipment in accordance with manufacturer's instructions.
- .2 Reduction from line size to pump connection size shall be made with eccentric reducers attached to the pump with tops flat to allow continuity of flow and to avoid air pockets.
- .3 Furnish and install a line size shut-off valve on the suction and discharge sides of the pumps.
- .4 Provide temperature and pressure gauges where and as detailed or directed.

- .5 Provide an adequate number of isolation valves for service and maintenance of the system and its components.
- .6 Circulating pump shall have sufficient capacity to circulate the scheduled GPM against the scheduled external head (feet) with the horsepower and speed as scheduled and/or as denoted on the drawings. Motors shall be of electrical characteristics as scheduled, denoted and/or as indicated on the electrical plans and specifications.
- .7 All piping shall be brought to equipment and pump connections in such a manner so as to prevent the possibility of any load or stress being applied to the connections or piping.
- .8 Power wiring, as required, shall be the responsibility of the electrical contractor. All wiring shall be performed per manufacturer's instruction and per applicable state, federal, and local codes.
- .9 Control wiring for remote mounted switches and sensor / transmitters shall be the responsibility of the control's contractor. All wiring shall be performed per manufacturer's instructions and applicable state, federal, and local codes.
- .10 Power and control wiring shall run in separate channel.
- .11 Pumps are supplied with an integrated VFD and should not be used with any external VFDs.
- .12 Pumps shall NOT be run dry to check rotation.
- .13 Make piping and electrical connections to pump and motor assembly and controls as indicated.
- .14 Ensure pump and motor assembly do not support piping.

3.3 INSTALLATION – ELEVATOR SUMP PUMP

- .1 Electrical wiring and protection must be in accordance with governing electrical codes.
- .2 Install proper Zoeller Unichheck (combination union and check valve).
- .3 When a Unichheck is installed, drill a 3/16" (5 mm) diameter hole in the discharge pipe even with the top of the pump. NOTE: THE HOLE MUST ALSO BE BELOW THE BASIN COVER AND CLEANED PERIODICALLY. Water stream will be visible from this hole when pump is operating.
- .4 Securely tape or clamp power cord to discharge pipe, clear of the float mechanism(s).
- .5 Use a discharge pipe equivalent in diameter to the pump's discharge.
- .6 Basin must be in accordance with governing codes and Specifications.
- .7 Pump must be level and float mechanism(s) clear of sides of basin before starting pump.
- .8 Basin must be clean and free of debris after installation.
- .9 Gate valve, shut-off valve, or ball valve to be supplied by installer and installed according to any and all codes.
- .10 Locate float switches as shown in sketches. The best place for the "off" point is above the motor housing and positioned 180° from the inlet. Never put "off" point below discharge on pump

3.4 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Check power supply.
 - .2 Check starter protective devices.
- .2 Start-up, check for proper and safe operation.
- .3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
- .4 Adjust flow from water-cooled bearings.
- .5 Adjust impeller shaft stuffing boxes, packing glands.

3.5 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.
 - .2 Procedures:
 - .1 Check power supply.
 - .2 Check starter O/L heater sizes.
 - .3 Start pumps, check impeller rotation.
 - .4 Check for safe and proper operation.
 - .5 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.
 - .6 Test operation of hands-on-auto switch.
 - .7 Test operation of alternator.
 - .8 Adjust leakage through water-cooled bearings.
 - .9 Adjust shaft stuffing boxes.
 - .10 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.
 - .11 Check base for free-floating, no obstructions under base.
 - .12 Run-in pumps for 12 continuous hours.
 - .13 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
 - .14 Adjust alignment of piping and conduit to ensure full flexibility.
 - .15 Eliminate causes of cavitation, flashing, air entrainment.
 - .16 Measure pressure drop across strainer when clean and with flow rates as finally set.
 - .17 Replace seals if pump used to degrease system or if pump used for temporary heat.
 - .18 Verify lubricating oil levels.

3.6 DOMESTIC HW CIRCULATING PUMPS

- .1 Balance flows using circuit setter balancing valve.

3.7 REPORTS

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports, supplemented as specified.
- .2 Include:

- .1 PV results on approved PV Report Forms.
- .2 Product Information report forms.
- .3 Pump performance curves (family of curves) with final point of actual performance.

3.8 TRAINING

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for domestic water service used in the following:
 - .1 Hard drawn copper domestic hot and cold water services inside building.
 - .2 Soft copper tubing inside building.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 21 05 01 - Common Work Results for Mechanical.
- .4 Section 21 05 01 - Common Work Results for Mechanical.
- .5 Section 23 05 01 - Installation of Pipework.
- .6 Section 23 05 23 - Valves.
- .7 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).
 - .1 ANSI/ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B 88M, Standard Specification for Seamless Copper Water Tube (Metric).
 - .3 ASTM F 492, Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings.
- .3 American Water Works Association (AWWA).
 - .1 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International).
 - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Ontario Building Code 2012

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Submit product data for following:
 - .1 Valves.
 - .2 Gauges.
 - .3 Vacuum Breakers.
 - .4 Backflow Preventers.
 - .5 Plumbing Fixtures.
- .3 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 STORAGE AND HANDLING

- .1 Comply with Section 01 60 00, Product Requirements.
- .2 Copper tubing shall be shipped to the job site on truck or in such a manner to protect the tubing. The tubing and fittings shall not be roughly handled during shipment. Tubing and fittings shall be unloaded with reasonable care.
- .3 Protect the stored product from moisture and dirt. Elevate above grade.
- .4 When stored inside, do not exceed the structural capacity of the floor.
- .5 Protect fittings and piping specialties from moisture and dirt.

PART 2 PRODUCTS

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B 88M.
 - .2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B 88M, in long lengths and with no buried joints.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 and larger: roll grooved to CSA B242.
- .6 Press Fitting: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect®) feature (or equal) design (leakage path). In ProPress ½" to 4" dimensions the Smart Connect Feature (or equal) assures leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

2.3 JOINTS

- .1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A 307, heavy series.
- .3 Solder: 95/5 tin copper alloy.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.
- .6 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F 492, complete with thermoplastic liner.
- .7 Press Fitting: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117.

2.4 GATE VALVES

- .1 50mm and under, soldered:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23 - Valves.
 - Kitz#44
- .2 50mm and under, screwed:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23 - Valves.
 - Kitz#24, Toyo#298
- .3 65mm and over, in mechanical rooms, flanged:
 - .1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS&Y bronze trim specified Section 23 05 23 - Valves.
 - Kitz#72, Toyo#421
- .4 65mm and over, other than mechanical rooms, flanged:
 - .1 Non-rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet specified Section 23 05 23 - Valves.
 - Kitz#75, Toyo#415

2.5 GLOBE VALVES

- .1 50mm and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 23 - Valves.
 - .2 Lockshield handles: as required.
 - Kitz#10
- .2 50mm and under, screwed:
 - .1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc as specified Section 23 05 23 - Valves.
 - .2 Lockshield handles: as required.
 - Kitz#03

2.6 SWING CHECK VALVES

- .1 50mm and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, **Y Pattern** bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23 - Valves.
 - Kitz#23, Toyo #237
- .2 50mm and under, screwed:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23 - Valves.
 - Kitz#22, Toyo#236
- .3 65mm and over, flanged:
 - .1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, regrind / renewable seat, bronze disc, bolted cap specified Section 23 05 23 - Valves.
 - Kitz#78, Toyo#435A

2.7 BALL VALVES

- .1 50mm and under, screwed:
 - .1 Class 150.
 - .2 Bronze body or Brass Body, chrome plated Solid brass or stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle as specified Section 23 05 23 - Valves.
 - .3 Solid bronze Ball, NO hollow ball acceptable:
 - .4 Standard of Acceptance:
 - Kitz#58, Toyo#5044A
- .2 50mm and under, soldered:
 - .1 To ANSI/ASME B16.18, Class 150.
 - .2 Bronze body or Brass Body, chrome plated Solid brass or stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23 - Valves.
 - .3 Solid bronze Ball, NO hollow ball acceptable:
 - .4 Standard of Acceptance:
 - Kitz#59, Toyo#5049A

2.8 BUTTERFLY VALVES

- .1 65mm and over, Lug style
 - .1 To MSS-SP-67, Class 125, 200Wog
 - .2 Cast iron body or ductile iron, Aluminum bronze disc. EPDM liner, Stainless steel stem. Valves 6" smaller shall be lever operator. 8" and above Gear Operator.
- .2 65mm and over, grooved ends:
 - .1 Class 300, bubble tight shut-off, bronze body.
 - .2 Operator: MASW50AED/ND-GG-S-LL (Lever) MAS W50AED/ND-GG-S-GO
 - .1 NPS 4 and under: lever handle.
 - .2 NPS 6 and over: gear operated.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with Ontario Building Code and local authority having jurisdiction.
- .2 Install pipe work in accordance with Section 23 05 01 - Installation of Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .5 Buried tubing:
 - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
 - .2 Bend tubing without crimping or constriction. Minimize use of fittings.

3.2 VALVES

- .1 Isolate equipment, fixtures and branches with gate or ball valves.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.3 PRESSURE TESTS

- .1 Conform to requirements of Section 21 05 01 - Common Work Results for Mechanical.
- .2 Test pressure: greater of 1.5 times maximum system operating pressure or 860 kPa.

3.4 FLUSHING AND CLEANING

- .1 During construction, plug or cap all piping to prevent entrance of foreign material.
- .2 Flush water piping systems until the issuing water is free of sediment.
- .3 Clean and reinstall all strainer baskets.
- .4 On completion of installation and testing of the potable water systems pre-flush, chlorinate, and thoroughly flush again in accordance with American Water Works Association (A.W.W.A.) C601 and C651.
- .5 Retain an independent inspection firm to supervise and inspect the chlorination and flushing procedures and perform chemical and biological tests as required.
- .6 Submit to the Consultant a certificate from the testing firm stating that the chlorination and flushing has been successfully carried out.
- .7 Acceptable Firms: Pace Chemicals, Dearborn Chemical, IPAC Chemicals.
- .8 Flushing without chlorination is acceptable for process water systems.

3.5 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that air chambers, expansion compensators are installed properly.

3.6 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.
- .2 Upon completion, provide laboratory test reports on water quality for Consultant approval.

3.7 START-UP

- .1 Timing: Start up after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - .3 Bring Domestic Hot Water Tank(s) up to design temperature slowly.
 - .4 Monitor piping systems for freedom of movement, pipe expansion as designed.
 - .5 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.8 PERFORMANCE VERIFICATION

- .1 Timing:
 - .1 After pressure and leakage tests and disinfection completed, and certificate of completion has been issued by authority having jurisdiction.
- .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 Test. Adjust and balance domestic hot and cold water systems in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .4 Sterilize domestic hot and cold water systems for Legionella control.
 - .5 Verify performance of temperature controls.
 - .6 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.
- .3 Reports:
 - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, using report forms as specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.

- .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.9 OPERATION REQUIREMENTS

- .1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 05 - Installation of Pipework.

END OF SECTION

PART 1 GENERAL SUMMARY

.1 Drainage Piping suitable materials for service:

SERVICE	MATERIAL			Specification Section
	TYPE OF PIPE AND FITTING	ABOVE GRADE	BELOW GRADE	
Sanitary Drains and Vents	Cast Iron	O	O	22 13 17
	Copper and Brass Pipe	O	O	22 13 17
	Copper Tube (Type L)	O	O	22 13 17
	Copper Tube (Type DWV)	O	X	22 13 17
	ABS	X	O	22 13 18
	PVC	O	O	22 13 18
Storm Drain	Cast Iron	O	X	22 13 17
	PVC	O	O	22 13 18
Legend: X – Not Permitted O - Permitted				

1.2 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 45 00 – Quality Control
- .3 Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .4 Section 01 78 00 – Closeout Submittals.
- .5 Section 21 05 01 – Common Work Results for Mechanical

1.3 REFERENCES

- .1 ASTM International Inc.

- .1 ASTM B 32, Standard Specification for Solder Metal.
 - .2 ASTM B 306, Standard Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C 564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
-
- .2 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .2 CAN/CSA-B125.3, Plumbing Fittings.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

PART 2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary and vent Type DWV to: ASTM B 306.
 - .1 Fittings.
 - .1 Cast brass: to CAN/CSA-B125.3.
 - .2 Wrought copper: to CAN/CSA-B125.3.
 - .2 Solder: lead free, tin- 95:5, type TA to ASTM B 32.

2.2 CAST IRON PIPING AND FITTINGS

- .1 Above ground sanitary, storm and vent: to CAN/CSA-B70.
 - .1 Joints:
 - .1 Mechanical joints:
 - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

PART 3 EXECUTION

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install in accordance with Ontario Plumbing Code, Ontario Building Code and local authority having jurisdiction.
- .2 General:

- .1 Install straight, parallel and close to walls and ceilings, with specified pitch. Use standard fittings for direction changes.
- .2 Install groups of piping parallel to each other; spaced to permit application of insulation, identification and service access on trapeze hangers.
- .3 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.
- .4 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.
- .5 Brass and copper pipe and tubing shall be free from surface damage. Replace damaged pipe or tubing.
- .6 Ream ends of pipes and tubes before installation.
- .7 Lay copper tubing so that it is not in contact with dissimilar metal and will not be kinked or collapsed.
- .8 Use non-corrosive lubricant or teflon tape applied to male thread.
- .9 Grooved pipe ends: cut square, seating surface to be clean and free from indent and score marks.
- .10 Install swing or swivel joints to connect risers to mains. Use coupling in risers from one floor outlet to next.
- .11 Install flanges or unions to permit removal of equipment without disturbing piping systems.
- .12 Clean ends of pipes or tubing and recesses of fittings to be braced or soldered. Assemble joints without binding.

.3 Sanitary Drainage: Make connection to building sanitary drain as shown.

.4 Equipment Drainage: Install drain valves at low points (where required) and run drain piping for all equipment requiring drainage (coils, drain pans, air handling units, etc.) to discharge into floor or hub drain.

3.3 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
 - .1 Verify domes are secure.
 - .2 Ensure weirs are correctly sized and installed correctly.
 - .3 Verify provisions for movement of roof system.
- .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 All pipe and fittings provided by this Section shall be approved by all Authorities and meet all regulations. The products shall bear all necessary labels and markings including the CSA logo for CSA certifications and a ULC label to confirm Flame Spread Rating and or Smoke Developed Classification values. Do not install pipe or fittings that fail to meet the Plumbing and Building Code requirements. Secure these approvals prior to installation
- .2 Drainage Piping suitable materials for service:

SERVICE	MATERIAL			Specification Section
	TYPE OF PIPE AND FITTING	ABOVE GRADE	BELOW GRADE	
Sanitary Drains and Vents	Cast Iron	O	O	22 13 17
	Copper and Brass Pipe	O	O	22 13 17
	Copper Tube (Type L)	O	O	22 13 17
	Copper Tube (Type DWV)	O	X	22 13 17
	ABS	X	O	22 13 18
	PVC	O	O	22 13 18
Process Sanitary Drains and Vents	ABS	X	O	22 13 18
	PVC	O	X	22 13 18
Storm Drain	Cast Iron	O	X	22 13 17
	PVC	O	O	22 13 18
Legend: X – Not Permitted O - Permitted				

1.2 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.

- .2 Section 01 45 00 – Quality Control
- .3 Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .4 Section 01 78 00 – Closeout Submittals.
- .5 Section 21 05 01 – Common Work Results for Mechanical

1.3 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM D 2235, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
 - .2 ASTM D 2564, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-Series B1800, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

PART 2 PRODUCTS

2.1 Material/Component Standards

- .1 ABS Pipe and Fittings: to CAN/CSA-B18.1.1-M.
- .2 PVC Pipe and Fittings: to CAN/CSA-B181.2-M.
- .3 Polyethylene Pipe and Fittings: to CAN/CSA-B137.1-M
- .4 Plastic Underground Drainage Pipe and Fittings: to CAN/CSA-B182.1.

2.2 SANITARY, STORM AND VENT PIPE AND FITTINGS (UNDERGROUND ONLY)

- .1 For sizes 40mm and larger, IPEX 'System 15' (or approved equal) PVC DWV Pipe and Fittings certified to CSA B181.2 shall be installed. The joining method for 'System 15' (or approved equal) pipe and fittings shall include the use of either (a) Purple primer for PVC (Xirtec 7) and CSA certified PVC solvent cement (IPEX 'System 15' Two-Step), or (b) for sizes no greater than 6 inches, IPEX 'System 15' One-Step PVC Cement, both as supplied by IPEX Inc. (Contact IPEX Inc. prior to installation for proper cementing procedures). Pipe and fittings shall have a third-party listing from ULC or ITS to exhibit a Flame Spread Rating of not greater than 25 when tested according to ULC S102.2.

2.3 SANITARY, STORM AND VENT PIPE AND FITTINGS (ABOVE GROUND (PLENUM RATED))

- .1 For sizes 40mm and larger, IPEX 'System XFR' (or approved equal) PVC DWV Pipe and Fittings certified to CSA B181.2 shall be installed. The joining method for 'System XFR' shall be as indicated above. Pipe and fittings shall have a third-party listing from ULC or ITS to exhibit a Flame Spread Rating of not greater than 25 and a Smoke Developed Classification of not greater than 50 when tested according to ULC S102.2.

2.4 JOINTS

- .1 Solvent weld for PVC: to ASTM D 2564.
- .2 Solvent weld for ABS: to ASTM D 2235.
- .3 For sizes 40mm and larger, IPEX 'System XFR' PVC DWV Pipe and Fittings certified to CSA B181.2 shall be installed. The joining method for 'System XFR' shall be as indicated above. Pipe and fittings shall have a third-party listing from ULC or ITS to exhibit a Flame Spread Rating of not greater than 25 and a Smoke Developed Classification of not greater than 50 when tested according to ULC S102.2.

PART 3 EXECUTION

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 In accordance with Section 23 05 05 - Installation of Pipework.
- .2 Install in accordance with Ontario Building Code, Ontario Provincial Plumbing Code and local authority having jurisdiction.

3.3 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
 - .1 Verify domes are secure.
 - .2 Ensure weirs are correctly sized and installed correctly.
 - .3 Verify provisions for movement of roof system.
- .4 Ensure fixtures are properly anchored, connected to system and effectively vented.

- .5 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 21 05 01 – Common Work Results for Mechanical.

1.2 REFERENCES

- .1 Canadian Gas Association (CGA)
 - .1 ANSI Z21.10.1/CSA 4.1, Gas Water Heaters - Volume I, Storage Water Heaters With Input Ratings Below 75,000 Btu Per Hour.
 - .2 ANSI Z21.10.3/CSA 4.3, Gas Water Heaters - Volume III - Storage Water Heaters, with Input Ratings Above 75,000 Btu Per Hour.
 - .3 CSA-B149.1, Natural Gas and Propane Installation Code.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CAN/CSA-C309, Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.
- .3 ASHREA 90.1

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.
 - .1 General arrangement, drawing of the boiler including product description, model number, dimensions, terminal points, instrumentation test connections.
 - .2 Clearances for operation, maintenance, servicing.
 - .3 Foundations with loadings, anchor bolt arrangements.
 - .4 Piping hook-ups.
 - .5 Equipment electrical drawings.
 - .6 Schematic wiring diagram of system. Schematic wiring diagram shall be ladder-type showing all components, interlocks, etc. Schematic wiring diagram shall clearly identify factory wiring and field wiring.
 - .7 All miscellaneous equipment.
 - .8 Venting configuration.
 - .9 Schematic flow diagram of gas valve trains.
 - .10 Installation Instructions: Manufacturer's printed instructions for installation shall be submitted to the engineer for approval.

1.4 Quality assurance submittals

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .3 Operation and Maintenance Manuals: manufacturer's printed operation and maintenance manuals shall be submitted.
 - .4 Manufacturer's Warranties: Manufacturer's printed warranties, as specified hereinafter, shall be submitted.
 - .5 Manufacturer's field service: manufacturer's printed field service procedures shall be submitted. Field service procedures shall include the name of the boiler manufacturer's field service manager and phone number of boilers manufacturer's field service department.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 WARRANTY

- .1 The manufacturer shall warrant each domestic hot water heater, including tank, trim, burner, control system, and all related components, accessories, and appurtenances against defects in workmanship and material for a period of twelve (12) months from date of substantial completion of the project. Heat exchanger and fuel burner shall be warranted for a period of five (5) years from date of shipment.

PART 2 PRODUCTS

- .1 Meets or exceeds the thermal efficiency and standby loss requirements of the current edition ASHRAE 90.1

2.2 GAS (POWER BURNER)

- .1 Natural Gas water heaters of capacity on mechanical drawings.
- .2 Minimum 95% thermal efficiency.
- .3 Maximum Hydrostatic working pressure of 160PSI.
- .4 Seamless glass lined steel tank construction, with glass lining applied to all water-side surfaces after the tank has been assembled and welded.
- .5 Modulating gas burner that automatically adjusts the input based on demand. 2.
- .6 Powered anodes that are non sacrificial and maintenance free. 3.
- .7 Meets the thermal efficiency and/or standby loss requirements of the current edition of ASHRAE/IES 90.1;
- .8 Have foam insulation
- .9 CSA Certified and ASME rated T&P relief valve;

- .10 Have a down-fired power burner designed for precise mixing of air and gas for optimum efficiency, requiring no special calibration on start-up;
- .11 Be approved for 0" clearance to combustibles.
- .12 The control shall be an integrated solid-state temperature and ignition control device with integral diagnostics, graphic user interface, fault history display, and shall have digital temperature readout
- .13 Basis of Design:
 - .1 AO Smith – BTH-500(A)
- .14 Acceptable equals:
 - .1 Lochinvar
 - .2 Rheem

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations.
- .2 Install natural gas fired domestic water heaters in accordance with CSA-B149.1.

3.2 FIELD QUALITY CONTROL

- .1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.

END OF SECTION

PART 1 GENERAL SUMMARY

- .1 Section Includes:
 - .1 The supply and installation of Plumbing Fixtures and Trim.
 - .2 Refer to Plumbing Fixture Schedule on drawing M030
- .2 Products Installed but not Supplied Under this Section:
 - .1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.
 - .2 Equipment installed by others.
 - .1 Connect with unions.
 - .3 Equipment not installed.
 - .1 Capped for future connection by others.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 22 11 18 – Domestic Water Piping Copper
- .5 Section 22 13 17 – Drainage Waste and Vent Piping – Cast Iron and Copper
- .6 Section 22 13 18 – Drainage Waste and Vent Piping - Plastic

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-B45 Series, Plumbing Fixtures.
 - .2 CAN/CSA-B125, Plumbing Fittings.
 - .3 CAN/CSA-B651, Barrier-Free Design.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.5 DELIVERY STORAGE AND DISPOSAL

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

PART 2 PRODUCTS

2.1 PLUMBING FIXTURE SCHEDULE

- .1 The "Plumbing Fixture Schedule" lists all commercial plumbing fixtures supplied under this Division and is shown on drawing M030.
- .2 Read this schedule, together with the drawings and other Sections of this Specification specific to each area of construction, in order to determine the scope of the Division 22 Plumbing work required for the plumbing fixtures listed.

2.2 MATERIAL

- .1 Provision of plumbing and drainage systems, providing new waste, drainage, vent, hot and cold water piping systems complete with new fixtures and equipment as indicated on the plumbing drawings and as per the plumbing fixture schedule.
- .2 In case of discrepancy between architectural and mechanical drawings as to number and location of fixtures, the architectural drawings shall govern.
- .3 Plumbing fixtures and fittings shall be product of one manufacturer and of same colour in any one washroom or location and to be as per drawing fixture schedule.
- .4 Materials: Vitreous china to CSA B45.1. Plumbing fittings to CSA B125. Exposed plumbing brass and metal work shall be heavy triple chromium plated.

2.3 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.
- .3 Exposed plumbing brass to be heavy triple chromium plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.
- .7 Fixture piping:
 - .1 Hot and cold water supplies to each fixture:
 - .1 Chrome plated rigid supply pipes each with handwheel stop, reducers, escutcheon.
 - .2 Waste:
 - .1 Brass P trap with clean out on each fixture not having integral trap.
 - .2 Chrome plated in all exposed places.
- .8 Chair carriers:
 - .1 Factory manufactured floor-mounted carrier systems for all wall-mounted fixtures.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Mounting heights:
 - .1 Standard: as per architectural drawings and elevations and the Ontario Building Code and the local requirements of all the authorities having jurisdiction.
 - .2 Wall-hung fixtures: as indicated on the architectural drawings and elevations and the Ontario Building Code, and the local requirements of all the authorities having jurisdiction, measured from finished floor.
 - .3 Physically handicapped: to comply with most stringent of the Architectural Drawings and Elevations, Ontario Building Code, and the local requirements of all the authorities having jurisdiction or CAN/CSA B651.
 - .4 Contractor to provide a mock-up of fixtures as required by the consultant to ensure that there are no interferences with fixtures, sensor operated flush valves, grab bars and bathroom accessories. Contractor to provide at a minimum the fixtures, grab bars, sensors and bathroom accessories for a typical Barrier Free Water closet. Other mock-ups maybe required at the consultants request.

3.2 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
 - .1 Aerators: operation, cleanliness.
 - .2 Vacuum breakers, backflow preventers: operation under all conditions.
- .4 Thermostatic controls:
 - .1 Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for plumbing specialties and accessories.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 22 11 18 – Domestic Water Piping Copper
- .5 Section 22 13 17 – Drainage Waste and Vent Piping – Cast Iron and Copper
- .6 Section 22 13 18 – Drainage Waste and Vent Piping – Plastic

1.3 REFERENCES

- .1 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A 126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
- .2 American Water Works Association (AWWA).
 - .1 AWWA C700, Cold Water Meters-Displacement Type, Bronze Main Case.
 - .2 AWWA C701, Cold Water Meters-Turbine Type for Customer Service.
 - .3 AWWA C702-1, Cold Water Meters-Compound Type.
- .3 Canadian Standards Association (CSA International).
 - .1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
 - .2 CSA-B79, Floor, Area and Shower Drains, and Cleanouts for Residential Construction.
 - .3 CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.
 - .2 Indicate dimensions, construction details and materials for specified items.
- .3 Shop Drawings:
 - .1 Submit shop drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions, construction and assembly details and accessories for all fixture as required for system installation and indicated in the plumbing fixture schedule
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturers' Field Reports: manufacturers' field reports specified.
- .7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:
 - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Installation shall be in strict accordance with the current editions of the Ontario Plumbing Code, Ontario Building Code, and local requirements of all authorities having jurisdiction.
- .2 All material to be CSA approved for intended application.

2.2 FLOOR DRAINS

- .1 Refer to the plumbing fixture schedule on drawing M030.
- .2 All floor drains to correspond to the flooring type. Refer to architectural drawings for details. In case of discrepancy between architectural and mechanical drawings as to the flooring type and associated drain type, the architectural drawings shall govern.
- .3 In case of discrepancy between architectural and mechanical drawings as to number and location of Floor Drains, the Mechanical drawings shall govern.

2.3 ROOF DRAINS

- .1 Provided and installed by Div. 22 where indicated on drawings, size indicated on plumbing roof plans. Connected to storm drainage system by Div. 22.

2.4 CLEANOUTS

- .1 Refer to the plumbing fixture schedule.
- .2 Quantities shown on drawings are for coordination of specific cleanouts. Provide all clean outs, additional to those shown on plans as required to conform to OBC.

2.5 NON-FREEZE WALL HYDRANTS

- .1 Refer to the plumbing fixture schedule.

2.6 VACUUM BREAKERS

- .1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric.

2.7 WATER HAMMER ARRESTORS

- .1 Water hammer arrestors (shock absorbers). Provide arrestors to Plumbing and Drainage Institute Standard PD1-WH 201 on branch supplies to each fixture or group of fixtures.
- .2 Copper construction, bellows or piston type: to PDI-WH201.

2.8 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

2.9 BACK FLOW PREVENTERS

- .1 Preventers: to CSA-B64 Series, application as indicated.

2.10 TRAP SEAL PRIMERS

- .1 Trap Seal Primers: Traps in floor drains require priming according to plumbing code. Provide priming device piped to nearest lavatory, urinal or water closet so that device will introduce regulated amount of water into trap whenever fixture is used. All floor drains require a TSP device.
- .2 Refer to plumbing Fixture Schedule.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 INSTALLATION

- .1 Installation shall be in strict accordance with the current editions of the Ontario Plumbing Code, Ontario Building Code, and local requirements of all authorities having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.3 CLEANOUTS

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.

3.4 NON-FREEZE WALL HYDRANTS

- .1 Install 600 mm above finished grade unless otherwise indicated.

3.5 TRAP SEAL PRIMERS

- .1 Install for all floor drains, hub drains, funnel floor drains and condensate drains from rooftop mechanical equipment and elsewhere, as indicated.
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space.
- .3 Install soft copper tubing to floor drain.

3.6 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.
- .2 Timing: start-up only after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.

3.7 TESTING AND ADJUSTING

- .1 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After certificate of completion has been issued by authority having jurisdiction.
- .2 Application tolerances:
 - .1 Pressure at fixtures: +/- 70kPa.
 - .2 Flow rate at fixtures: +/- 20%.
- .3 Adjustments:
 - .1 Verify that flow rate and pressure meet design criteria.
 - .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .4 Floor drains:
 - .1 Verify operation of trap seal primer.
 - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.
 - .3 Check operations of flushing features.
 - .4 Check security, accessibility, removeability of strainer.
 - .5 Clean out baskets.
- .5 Roof drains:
 - .1 Check location at low points in roof.
 - .2 Check security, remove ability of dome.
 - .3 Adjust weirs to suit actual roof slopes, meet requirements of design.
 - .4 Clean out sumps.
 - .5 Verify provisions for movement of roof systems.
- .6 Vacuum breakers, backflow preventers, backwater valves:
 - .1 Test tightness, accessibility for O&M of cover and of valve.
 - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers,

- backflow preventers.
 - .3 Verify visibility of discharge from open ports.
- .7 Access doors:
 - .1 Verify size and location relative to items to be accessed.
- .8 Cleanouts:
 - .1 Verify covers are gas-tight, secure, yet readily removable.
- .9 Wall hydrants:
 - .1 Verify complete drainage, freeze protection.
 - .2 Verify operation of vacuum breakers.
- .10 Training:
 - .1 Demonstrate full compliance with Design Criteria.

END OF SECTION

PART 1 GENERAL SUMMARY

- .1 The intent is for all ductwork and HVAC related equipment to remain clean during construction. The contractor shall provide the following activities specified during all construction activities.
 - .1 HVAC Protection:
 - .1 Seal off all supply, return and exhaust air system openings to prevent the accumulation of dust and debris in the systems at all times unless work is being completed on the immediate area of the system using plastic seals to the approval of the Consultant. This is to include overnight and longer work stoppages. All diffusers, grilles, registers, laminar flow diffusers etc. are also to be sealed in plastic.
 - .2 Keep all construction areas clean and neat as specified elsewhere in this specification.
 - .3 Where ductwork and equipment become contaminated due to inadequate protection these ducts will be cleaned as specified in Section 23 01 31 – Air Duct Cleaning Systems.
- .2 Providing the consultant is satisfied that the activities as specified above have been performed through construction, the Section 23 01 31 – Air Duct Cleaning Systems shall be waived. The consultant reserves the right to enforce the Section 23 01 31 – Air Duct Cleaning Systems at their discretion.
- .3 Refer to Section 23 05 01 – Use of HVAC Systems During Construction.

1.2 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 23 05 01 – Use of HVAC Systems During Construction.
- .5 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa

1.3 REFERENCES

- .1 Definitions:
 - .1 HVAC System: complete air duct system from outside air intake louvers to furthest air supply terminal unit and including:
 - .1 Rigid supply and return ductwork;
 - .2 Flexible ductwork;
 - .3 Mixing plenum boxes;
 - .4 Return air plenums including ceiling plenums;
 - .5 Cooling and heating coils and compartments;
 - .6 Condensate drain pans, eliminator blades and humidifiers;
 - .7 Fans, fan blades and fan housing;
 - .8 Filter housing and frames;
 - .9 Acoustically insulated duct linings;
 - .10 Diffusers, registers and terminal units;
 - .11 Dampers and controls;
- .2 Reference Standards:
 - .1 National Air Duct Cleaners Association (NADCA)
 - .2 ACR Standard: Assessment, Cleaning and Restoration of HVAC Systems.

- .3 North American Insulation Manufacturers Association (NAIMA)
 - .1 NAIMA, Cleaning Fibrous Glass Insulated Duct Systems - Recommended Practices.
- .4 United States Environmental Protection Agency (US EPA)
 - .1 US EPA, 40 CFR Parts 152 and 156.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit cleaning plan developed during site evaluation.
 - .1 Ensure plan includes sequence of operation, identification of camera and cleaning apparatus insertion points and schedule for work.
- .3 Product Data:
 - .1 Submit manufacturer's printed product literature and data sheets for antimicrobial agents and include product characteristics, performance criteria and limitations.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide submittals in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Post Cleaning Inspection Report: submit 2 copies of Final Inspection Report, including data collected, observations and recommendations as well as following information:
 - .1 Name and address of facility;
 - .2 Name and address of HVAC cleaning contractor;
 - .3 Description of HVAC systems with drawings identifying systems cleaned;
 - .4 Identification scheme for location points in systems that were inspected with accompanying notes describing methods of inspection or tests used;
 - .5 Comments complete with photographs of each sampling location and other observed system features;
 - .6 Identify systems tested, observations, actions taken and recommendations for future maintenance.

PART 2 PRODUCTS

2.1 ACCESS DOORS AND PANELS

- .1 Equipment Access Doors and Panels: construct from same materials as equipment paneling complete with sealing gasket and positive locking device.
 - .1 Size access doors and panels in equipment to allow for inspection and cleaning.
- .2 Ductwork Access Doors: construct access doors from 1.27 minimum galvanized sheet steel with gasketed seal.
 - .1 Ensure access door is 25mm greater in every dimension than access opening.
 - .2 Access door size 200 mm x 200 mm minimum.
 - .3 Secure access doors with sheet metal screws on 75 mm centres minimum. Ensure 3 screws per side minimum.
- .3 Access Doors and Panels Acoustic Lining:
 - .1 Install acoustic lining to match existing.
 - .2 Self-adhesive glass fiber tape capable of adhering to both acoustic lining and metal access door or panel materials.
 - .3 Water-based duct sealer for repairing cut acoustic lining.

2.2 ANTIMICROBIAL AGENT

- .1 Use antimicrobial agents registered with US EPA-40 CFR.

2.3 SYSTEM FILTERS

- .1 Supply and install new filters for each HVAC System cleaned.

2.4 AIR DUCT CLEANING EQUIPMENT

- .1 Manually propelled full contact brushes:
 - .1 Ensure brushes are specifically manufactured and shaped to fit individual ducts, equipment and components of HVAC system.
 - .1 Ensure brushes are sized to fit various duct sizes in HVAC system.
 - .2 Ensure brushes make scrubbing motion and full contact with HVAC system interior surfaces to be cleaned.
- .2 Brushes: manually propelled with integrally-mounted motor and nylon or polypropylene or other non-metallic material bristles.
 - .1 Ensure motor has capacity to continue to push brush after bristles are distorted.
 - .2 Replace worn and ineffective brushes when required.

2.5 HEPA FILTER EVACUATION FAN

- .1 Evacuation Fan: includes fan, HEPA filter, flexible hose and motor capable of maintaining debris and particulates airborne in airstream until they reach evacuation fan and maintaining system under negative pressure.
 - .1 Ensure HEPA filters are clean and maintain evacuation fan and HEPA filter to run efficiently.

2.6 HEPA VACUUM UNIT

- .1 Vacuum Unit: includes vacuum fan, integral HEPA filter, suction hose and vacuum head, capable of maintaining HVAC System debris and particulates airborne in air stream until they reach vacuum unit and maintaining system under negative pressure.
 - .1 Ensure HEPA filters are clean and maintain vacuum unit and HEPA filter to run efficiently.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Close down HVAC system.
- .2 Locate and identify externally visible HVAC system features which may affect cleaning process including:
 - .1 Control devices;
 - .2 Fire and smoke control dampers;
 - .3 Balancing dampers: indicate and record positions for resetting;
 - .4 Air volume control boxes: indicate and record positions for resetting;
 - .5 Fire alarm devices;
 - .6 Monitoring devices and controls;
- .3 Cut openings in equipment panels and ductwork for access to system interior.
 - .1 Square or rectangular opening sizes: 200 mm minimum each side.

- .2 Circular opening sizes: 200mm minimum diameter.
- .4 Installation of Access Doors and Panels: install access doors and panels for equipment where required to facilitate system inspection and cleaning.
 - .1 Install access doors and panels for inspection and cleaning of equipment as follows:
 - .1 Filters;
 - .2 Dampers;
 - .3 Sensors;
- .5 Installation of Access Doors in Ductwork: install access doors in ductwork where required to facilitate system inspection and cleaning.
 - .1 Access door installation is not permitted in flexible ductwork.
 - .1 Inspect flexible ductwork only by disconnecting from main duct and inspecting from open end.
- .6 When acoustically lined duct is cut for access, repair cut edges of acoustic lining using self-adhesive fibre glass tape and water based duct sealer.
 - .1 Adhere new acoustic lining to match existing to inside of access panel or door to ensure continuity of acoustic properties of system.
- .7 Remove and reinstall ceiling tiles to gain access to HVAC system as required.
 - .1 Replace ceiling tiles damaged or soiled by air duct cleaning procedures.

3.2 EXAMINATION / PRE-CLEANING INSPECTION

- .1 Verification of Conditions:
 - .1 Make visual inspection of interior of HVAC system using remote controlled robotic camera.
 - .2 Insert camera at pre-established strategic locations to evaluate condition and cleanliness of HVAC systems and components.
- .2 Evaluation and Assessment:
 - .1 Identify location and type of internal components.
 - .2 Identify extent of potential problems.

3.3 DUCT CLEANING

- .1 Do duct cleaning in accordance with NADCA ACR Standard.
- .2 Isolate and clean sections in zones to ensure that dirt deposits and debris from zone being cleaned does not pass through another zones which has already been cleaned.
 - .1 Isolate zone of duct using closed-cell polyurethane foam or air inflated zone bag before cleaning.
- .3 Ensure vacuum units and evacuation fans are securely in place before starting cleaning operation of isolated section of HVAC air duct system.
- .4 Install HEPA filter evacuation fan at one end of zone section and insert full contact brushes at other end.
- .5 Clean HVAC supply air duct system and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square metres.
- .6 Clean exhaust, return, transfer ductwork and plenums, equipment and components where particulate sample collected from surfaces is greater than 75mg of particulate per 0.01 square metres.

- .7 Energize brushes to travel from insertion point to HEPA filter evacuation fan.
 - .1 Pass brushes through sections as often as necessary to achieve required cleanliness.
 - .2 Change brush sizes as required to ensure positive contact with duct and component interiors.
 - .3 Clean corners and pockets where dirt and debris can accumulate.
- .8 Clean equipment, components and other features in isolated zone before moving to next zone of HVAC air duct system.
- .9 Clean diffusers, registers, louvers, fan coils and cassette and other terminal units.

3.4 ACOUSTICALLY LINED DUCTWORK CLEANING

- .1 Clean glass fibre acoustically insulated ducts to NAIMA recommended practices.
 - .1 Use specifically designed robotic apparatus that has been demonstrated not to damage acoustic glass fibre lining.
 - .2 Monitor cleaning process progress by onboard camera.

3.5 COMPONENTS AND EQUIPMENT CLEANING

- .1 Brush and vacuum rooftop unit surfaces to achieve required cleanliness.
- .2 When cleaning equipment and components by brushing and vacuuming is inappropriate or insufficient, dismantle and remove equipment or component and move to area designated by Consultant for cleaning.
 - .1 Pressure wash with water and cleaning solution until required cleanliness is achieved.
 - .2 Clean equipment and components in place only if there is no hazard to adjacent materials.
- .3 Compressed air and manual cleaning is acceptable only for cleaning individual components and small areas as follows:
 - .1 Fan blades;
 - .2 Dampers;
 - .3 Turning vanes;
 - .4 Controls;
 - .5 Sensor bulbs;
 - .6 Fire alarms;
 - .7 Smoke detectors;

3.6 FIELD QUALITY CONTROL/FINAL INSPECTIONS

- .1 Post Cleaning Inspection: Carry out a visual final inspection and provide photo documentation after final cleaning has been completed.
 - .1 Identify on HVAC system record drawings access points used for inspection and cleaning.
 - .2 Reset components including dampers and sensors, which have been disturbed during cleaning operations.

3.7 SYSTEM STARTUP

- .1 Install new system filters after cleaning operations are completed.
- .2 Cover each inspection opening with access door or panel and secure in place after inspection and cleaning are completed.
- .3 Restart each HVAC system.

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Use of mechanical systems during construction.
- .2 Related Sections:
 - .1 Section 21 05 01 Common Work Results Mechanical
 - .2 Section 23 01 31 Air Duct Cleaning for HVAC Systems
 - .3 Section 23 05 93 HVAC Testing, Adjusting and Balancing

1.2 USE OF SYSTEMS

- .1 Use of new and existing permanent heating and ventilating systems for supplying temporary heat or ventilation is not permitted.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Co-operate and co-ordinate with the requirements of other units of work specified in other sections.
- .2 Provide complete piping system including:
 - .1 Refrigerant piping
 - .2 Plumbing systems (domestic, sanitary, storm)
 - .3 Natural gas piping system

1.2 RELATED REQUIREMENTS

- .1 Section 22 11 16 – Domestic Water Piping Copper
- .2 Section 22 13 17 – Drainage Waste and Vent Piping – Copper
- .3 Section 22 13 18 – Drainage Waste and Vent Piping – Plastic
- .4 Section 23 07 15 – Thermal Insulation for Piping
- .5 Section 23 11 23 – Facility Natural Gas Piping
- .6 Section 23 21 13.01 – Hydronic Systems Copper
- .7 Section 23 21 13.02 – Hydronic Systems Steel
- .8 Section 23 23 00 – Refrigerant Piping

1.3 REFERENCES

- .1 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .2 National Fire Code of Canada (NFCC 2005)
- .3 Ontario Building Code
- .4 CSA B149.1 – Natural Gas Code

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

PART 2 PRODUCTS

2.1 MATERIAL

- .1 Refer to appropriate specifications section for the service.
- .2 Paint: zinc-rich to CAN/CGSB-1.181.
 - .1 Primers, Paints: in accordance with manufacturer's recommendations for surface conditions.
- .3 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
- .4 Fire Stopping: in accordance with Section 07 84 00 - Fire Stopping. (All firestopping and smoke sealing required for mechanical service penetrations of rated walls, floors and partitions shall be the responsibility of Division 7).

PART 3 EXECUTION

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PIPING PREPARATION

- .1 Cut all piping square. Remove all burrs and slivers by filing.
- .2 Thoroughly clean copper pipe and fittings over entire contact surface before applying flux. Use non-corrosive flux only.
- .3 Threads in pipe and fittings shall be standard taper pipe thread. Make joints full length, full depth, clean cut, smooth, strong and free of imperfect threads.
- .4 Ream and countersink all threaded pipe ends to remove burrs. Wipe finished joints clean.
- .5 Clean all rust scale, paint, oil, or foreign matter from pipe surfaces prior to welding.

3.3 PIPING CONNECTIONS

- .1 Provide threaded joints for steel pipe 2" and smaller and welded joints for pipe 2 ½" and larger.
- .2 Use main sized saddle type weldolet branch connections. In steel pipe, branch lines may be directly connected to the main if the main is at least two times the branch size, for up to 6" mains, or if the main is at least 3 times the branch size for 8" and larger mains. Do not project branch lines inside main.
- .3 Cut openings in mains for Weldolets neatly and sized to suit fitting. Clean slag from inside of opening.
- .4 Assemble steel to cast iron flanged joints using flat faced steel flanges and full faced gaskets only.

- .5 Fit all flanged joints uniformly on contact faces of gaskets. Extend all bolts completely through their nuts. Use a mixture of graphite and oil or an anti-seize compound on all bolts.
- .6 Fit threaded joints using good quality pipe joint cement or teflon tape on male threads only. All joint compounds to be compatible with type of service pipe will carry.
- .7 Provide non-conducting type connections wherever jointing dissimilar metals. Brass adaptors and valves are acceptable.
- .8 Provide MJ couplings consisting of neoprene sleeve and stainless steel shield and clamps, for plain end cast iron pipe.
- .9 Use fittings with joints suitable for the type of pipe employed. Provide fittings of equal quality and thickness as the pipe to which they are attached.

3.4 CONNECTIONS TO EQUIPMENT

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.5 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer AND as indicated without interrupting operation of other system, equipment, components.

3.6 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain.
 - .1 Discharge to be visible.
- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.7 AIR VENTS

- .1 Install air vents where indicated on Drawings and on all high points of closed water systems. Fit with manual isolation cocks.
- .2 Provide safe drain fittings and copper drain tubing to nearest drain point, for air vents installed in areas where leakage could cause damage.
- .3 Install drain piping to approved location and terminate where discharge is visible.

3.8 DIELECTRIC COUPLINGS

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: isolating flanges.

3.9 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible and as indicated.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Install pipe straight, true and parallel, clean and free of rust and scale. Cap exposed ends during construction to prevent entrance of foreign material.
- .14 Provide clearance for proper installation of insulation and for access to valves, air vents, drains, unions, etc.
- .15 Provide approved plugs or caps on all lines left for future connection.
- .16 Run branch lines to fixtures, tanks, pumps, and other items of mechanical equipment to sizes shown on the drawings, regardless of whether tappings smaller than pipe size shown are provided.
- .17 Cut piping to measurements taken at the site and work into place without spring.
- .18 Make all connections to equipment and branch mains with unions or flanges. Provide flexible connections, vibration and expansion connectors at equipment as indicated.

- .19 Do not use bushings. Make reductions in water pipe sizes with eccentric reducing fittings installed so that top of mains form a straight line, free from air pockets.
- .20 Install piping to allow expansion and contraction without unduly stressing pipe or connected equipment. Provide for expansion compensation where pipe runs past building expansion joints. Locate and size expansion joints or loops to permit an expansion 50 percent greater than that required. Provide expansion loops where possible but where impracticable owing to space considerations provide an approved type of proprietary expansion compensator complete with pipe anchors and guides.
- .21 Repair all pipe coatings and linings after welding to the original condition Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use gate, ball or butterfly valves at branch take-offs for isolating purposes except where specified.
 - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
 - .8 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
- .22 Check Valves:
 - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
 - .2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.10 UNIONS, COUPLINGS, STRAINERS, ARRESTORS

- .1 Install unions and couplings where indicated on Drawings and at all equipment, to allow disassembly.
- .2 Install strainers on supply lines upstream of all automatic control devices, pressure regulating valves, circulator pumps.
- .3 Install water hammer arresters on hot and cold supply lines at quick closing valves and each fixture or group of fixtures to prevent water hammer. Install between fixtures being served and supply main. Install additional units on risers. Size arresters in accordance with manufacturer's standards and Plumbing and Drainage Institute WH201.
- .4 Air chambers may be installed in lieu of water hammer arresters provided no more than 3 fixtures are serviced by each air chamber.
- .5 Protect entire water distribution system against contamination due to backflow from non-potable sources. Refer to AWWA manual for cross connection control. Provide an approved backflow preventer for each connection to fixture or equipment for which approved air gap or vacuum breaker is not shown or specified elsewhere (e.g. in connection with fixture or equipment itself). Provide isolating valves and valved bypass, for each backflow preventer.
- .6 Install flexible connectors immediately adjacent to equipment subject to vibration and where indicated on the Drawings. Secure other end to prevent shaking or excessive movement.

3.11 VALVES

- .1 Install all valves indicated on Drawings or necessary for proper control and isolation of piping and equipment. All valves are to suit the particular service required.
- .2 All valves of similar type to be of one manufacturer.
- .3 Check all valves for specified criteria and proper operation before installation.
- .4 Orientate handwheels or operators as indicated on Drawings. When not indicated, orientate to most convenient location for operation.
- .5 Provide access to concealed valves.
- .6 Provide valves and piping that are compatible to avoid galvanic corrosion.
- .7 Use gate valves for shut-off valves unless indicated otherwise.
- .8 Lead Free Ball valves shall be used for shut-off valves on potable water systems.
- .9 Use globe valves for throttling service or where specifically indicated for shut-off service. Use globe valves for meter by-pass.
- .10 Use gate and globe valves with rising stems except where lack of space exists because of obstructions, in which case use non-rising stems.
- .11 Provide drain valves at main shut-off valves, and at low points of piping and equipment.
- .12 Provide isolating valves for each piece of equipment, including heating elements.

3.12 PIPE ROUTING AND GRADES

- .1 Route piping in an orderly manner, maintaining proper grades. Install to conserve headroom and interfere as little as possible with use of the space. Run exposed pipe parallel to walls. Group pipes wherever practical. Install concealed piping close to building structure to keep furring to a minimum.
- .2 Conceal piping in ceiling spaces and partitions where possible, except in mechanical room. Where pipes cannot be concealed, obtain details of pipe run from the Consultant.
- .3 Slope water piping 0.25% and arrange for drainage at low points; provide proper air relief.
- .4 Equip low points of all closed systems with $\frac{3}{4}$ " drain valves and hose nipples. Provide high capacity float operated automatic air vents at all high points.
- .5 Install storm and sanitary drains to invert elevations and slopes indicated on the drawings. Where invert elevations and slopes are not shown install piping to the minimum requirements of the Plumbing Code, generally 2% minimum slope for sizes 3" and smaller, and for all branch lines, and 1% minimum slope for building drains 4" and larger.
- .6 Install drain lines from drain points in concealed locations or inaccessible areas to nearest floor drain.

3.13 SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
 - .2 Other floors: terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere:
 - .1 Provide space for firestopping.
 - .2 Maintain fire rating integrity.
 - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.14 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: one piece type with set screws.
 - .1 Chrome or nickel plated brass or type 302 stainless steel..
- .3 Sizes: outside diameter to cover opening or sleeve.
 - .1 Inside diameter to fit around pipe or outside of insulation if so provided.

3.15 PREPARATION FOR FIRE STOPPING

- .1 All firestopping and smoke sealing required for mechanical service penetrations of rated walls, floors and partitions shall be the responsibility of Division 7. Firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.16 FLUSHING OUT OF PIPING SYSTEMS

- .1 Flush system in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

3.17 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Conduct tests and pay for all associated work including making good and re-testing when required.
- .2 Notify Consultant 48 hours in advance of date when tests will be conducted.
- .3 Make sure all work has been tested and approved prior to insulating or concealing.
- .4 Carry out tests in the presence of the Consultant and the Authority having jurisdiction.
- .5 Forward written test results to the Consultant.
- .6 Schedule of Tests:

Service Test	Testing		
	<u>Pressure</u>	<u>Fluid</u>	<u>Duration</u>
Water Systems	200 psi	Water	2 hours
Natural Gas	75 psi	Air	24 hours
Drainage Systems	5 psi	Water	6 hours

 - .1 Carry out tests on the natural gas system in accordance with applicable codes and regulations.
 - .2 Carry out tests on the water supply and drainage systems in accordance governing bodies.
 - .3 Leave all work uncovered until completion of testing. However, should the construction schedule require that work be covered, carry out tests on portions of system prior to system completion. Give a minimum of 48 hours notice to Consultant of such prior testing.
- .7 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .8 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .9 Pay costs for repairs or replacement, retesting, and making good.
- .10 Insulate or conceal work only after approval and certification of tests.

3.18 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 At all times keep the premises free from accumulations of waste material or rubbish caused by employees or work, and at the completion of the work, remove all rubbish and all tools, equipment and surplus materials from and about the work and leave the work "broom clean" or its equivalent, unless more exactly specified.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for flexible connections, expansion joints, anchors and guides for building services piping.
- .2 Install piping to allow expansion and contraction without unduly stressing pipe or connected equipment. Provide for expansion compensation where pipe runs past building expansion joints and where required based on pipe sizing and anchor points. Contractor to provide proposed locations on plans for review by engineer. Locate and size expansion joints or loops to permit an expansion 50 percent greater than that required. Provide expansion loops where possible but where impracticable owing to space considerations provide an approved type of expansion compensator complete with pipe anchors and guides.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 21 05 01 - Common Work Results for Mechanical
- .5 Section 23 05 05 – Installation of Mechanical Piping systems
- .6 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .7 Section 23 08 01 - Performance Verification Mechanical Piping Systems.

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
- .1 ASTM A 53/A 53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A 105/A 105M, Standard Specification for Carbon Steel Forgings, for Piping Applications.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data and indicate for item as applicable:
 - .1 Manufacturer, model number, line contents, pressure and temperature rating.
 - .2 Proposed location on Plan drawings for each system.
 - .3 Movement handled, axial, lateral, angular and the amounts of each.
 - .4 Nominal size and dimensions including details of construction and assembly.
- .3 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
- .4 Data to include:
 - .1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

PART 2 PRODUCTS

2.1 SLIP TYPE EXPANSION JOINTS

- .1 Application: for axial pipe movement, as indicated.
- .2 Repacking: under full line pressure.
- .3 Body and packing housings: Class 150, 1MPa carbon steel pipe to ASTM A 53/A 53M, Grade B. Wall thickness to match pipe with raised face slip-on or weld neck flanges to match pipe.
- .4 Slip or traverse sleeves: carbon steel pipe to ASTM A 53/A 53M, Grade B.
- .5 Anchor base: construction steel, welded to body.
- .6 Guides (internal and external): embody into packing housing with concentric alignment of slip or traverse sleeve with packing housing.
- .7 Extension limit stop: stainless steel, to prevent over-extension with accessible and removable pins.
- .8 Packing rings: 6 minimum, PTFE or graphite impregnated non-asbestos.
- .9 Thermal plastic packing: PTFE or graphite impregnated non-asbestos slug supplied loose.
- .10 Lubricating fittings: pet cocks with grease nipple.
- .11 Plunger body and plunger:
 - .1 Plunger body: heavy wall carbon steel welded to body.
 - .2 Plunger: carbon steel with hex head for use with socket wrench.
- .12 Lubricant: to manufacturer's recommendations.
- .13 Lubricant gun: complete with hose assembly.

2.2 BELLOWS TYPE EXPANSION JOINTS

- .1 For axial, lateral or angular movements, as indicated.
- .2 Maximum operating pressure: to suit service.
- .3 Maximum operating temperature: to suit service.
- .4 Type B: externally pressurized, constant volume, pressure balanced, designed to eliminate pressure thrust, factory tested to 1 ½ times maximum working pressure. Furnish test certificates.
- .5 Bellows:
 - .1 Multiple bellows, hydraulically formed, single ply, for specified fluid, pressure and temperature, water treatment and pipeline cleaning procedures.
- .6 Reinforcing or control rings:
 - .1 2 piece nickel iron.
- .7 Ends:
 - .1 flanges to match pipe.
- .8 Liner:
 - .1 Austenitic stainless steel in direction of flow.

- .9 Shroud:
 - .1 Carbon steel, painted.

2.3 FLEXIBLE CONNECTION

- .1 2" diameter and smaller:
 - .1 flexible metallic connector constructed of corrugated stainless steel or bronze hose with heavy mesh braided cover minimum 12" long with union connections.
- .2 Over 2" to 4" diameter:
 - .1 flexible metallic connector constructed of corrugated stainless steel or bronze hose with heavy mesh braided cover minimum 15" long with flanged connections.
- .3 Over 4" diameter:
 - .1 Wire reinforced rubber vibration joints complete with retaining rings, stretcher plates, bolts, washers and companion flanges.
- .4 Use flexible connectors suitable for the conditions of temperature and pressure encountered.

2.4 ANCHORS AND GUIDES

- .1 Anchors:
 - .1 Provide as required.
- .2 Alignment guides:
 - .1 Provide as required.
 - .2 To accommodate specified thickness of insulation.
 - .3 Vapour barriers, jackets to remain uninterrupted.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install expansion joints with cold setting, required to allow expansion and contraction without unduly stressing pipe or connected equipment. Make record of cold settings.
- .2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.
- .3 Install pipe anchors and guides as indicated. Anchors to withstand 150 % of axial thrust.

3.2 CLEANING AND START-UP

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

3.3 PERFORMANCE VERIFICATION

- .1 In accordance with Section 23 08 01 - Performance Verification: Mechanical Piping Systems.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for thermometers and pressure gauges in piping systems.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 21 05 01 - Common Work Results for Mechanical
- .4 Section 23 05 05 - Installation of Pipework
- .5 Section 23 05 53.01 - Mechanical Identification.

1.3 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B40.100, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
 - .2 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data.
- .3 Submit manufacturer's product data for following items:
 - .1 Thermometers.
 - .2 Pressure gauges.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Design point to be at mid point of scale or range.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial style, mercury in glass, red reading, black numerals, aluminum case, glass window, adjustable angle, 225mm long, variable angle type with separable well.
- .2 Celsius scale, selected so normal operating point is approximately mid scale; 1% accuracy.
- .3 Standard of Acceptance: Weksler AA5, Trefice, Weis.

2.3 REMOTE READING THERMOMETERS

- .1 100 mm diameter liquid filled activated dial type: to CAN/CGSB-14.5 ASME B40.200, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished brass case for wall mounting.

2.4 THERMOMETER WELLS

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: brass or stainless steel.
- .3 Separable socket suitable for stem type thermometer with gasket and cap.

2.5 PRESSURE GAUGES

- .1 Dial size 110mm, aluminium case, chrome ring, bronze movement, phosphor bronze bourdon tube.
- .2 Metric scale (Pa/kPa) selected so that normal operating point is approximately mid scale; 1% accuracy
- .3 Accessories - lever handle cock
- .4 Standard of Acceptance: Weksler BA1, Trerice, Weis
- .5 Provide:
 - .1 Snubber for pulsating operation.
 - .2 Diaphragm assembly for corrosive service.
 - .3 Gasketed pressure relief back with solid front.
 - .4 Bronze stop cock.

PART 3 EXECUTION

3.1 GENERAL

- .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

- .1 Install in wells on piping. Provide heat conductive material inside well.
- .2 Install in locations as in indicated and on inlet and outlet of:
 - .1 Heat Exchangers.
 - .2 DHW Heaters.
- .3 Install wells for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

- .1 Install in following locations:

- .1 Suction and discharge of pumps.
 - .2 Upstream and downstream of PRV's.
 - .3 Upstream and downstream of control valves.
 - .4 Inlet and Outlet of Heat Exchangers.
 - .5 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere.
 - .3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

- .1 Install engraved lamicoid nameplates as specified in Section 23 05 53.01 - Mechanical Identification, identifying medium.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Domestic Water Systems (Hot and Cold) (Lead Free) up to 1400 kPa
 - .2 Heating up to 1050 kPa.
 - .3 Heating 1051 kPa to 1750 kPa.
 - .4 Specialties
- .2 Use the following valves for all piping systems provided by this Section, unless specified otherwise. Use rising stem where space permits. Use flanged, screwed or solder ends to suit pipe lines, and non-heating malleable iron handles.
- .3 Use only industrial class valves meeting ANSI, ASTM, ASME and applicable MSS standards. Specification MSS-SP-80, MSS-SP-110, MSS-SP-70, 85, 71, MSS-SP-72, MSS-SP-67.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 21 05 01 - Common Work Results for Mechanical
- .5 Section 23 05 05 - Installation of Pipework.
- .6 Section 22 11 16 - Domestic Water Piping – Copper
- .7 Section 23 21 13.01 – Hydronic Systems: Copper
- .8 Section 23 21 13.02 – Hydronic Systems: Steel

1.3 REFERENCES

- .1 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.
- .2 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
 - .1 ANSI/ASME B1.20.1, Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ASTM A 49, Specification for Heat-Treated Carbon Steel Joint Bars.
 - .4 ASTM A 126, Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .5 ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM B 85, Specification for Aluminum-Alloy Die Castings.
 - .7 ASTM B 209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - .8 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings.
 - .9 ANSI/ASME B16.10, Face-to-Face and End-to-End Dimensions Valves.
 - .10 ANSI/ASME B16.25, Buttwelding Ends.
 - .11 ANSI/ASME B16.34, Valves - Flanged, Threaded and Welding End.
- .3 American Society for Testing and Materials International, (ASTM).

- .1 ASTM A 276, Specification for Stainless Steel Bars and Shapes.
- .2 ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
- .3 ASTM B 283, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
- .4 ASTM B 505/B 505M, Specification for Copper-Base Alloy Continuous Castings.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
 - .1 MSS-SP-25, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS-SP-80, Bronze Gate Globe, Angle and Check Valves.
 - .3 MSS-SP-110, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
 - .4 MSS SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .5 MSS SP-71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .6 MSS SP-82, Valve Pressure Testing Methods.
 - .7 MSS SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
 - .8 MSS SP-61, Pressure Testing of Steel Valves.
 - .9 MSS SP-78, Cast Iron Plug Valves, Flanged and Threaded Ends.
 - .10 MSS SP-67, Butterfly Valves.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit data for valves specified in this section.
- .3 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

- .1 Provide valves of same manufacturer throughout, where possible.
- .2 Provide valves with manufacturer's name and pressure rating clearly marked on body (per MSS-SP-25).
- .3 Product shall carry valid CRN (Canadian Registration Number) issued by respective Provinces.

1.6 DELIVERY STORAGE AND DISPOSAL

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

PART 2 PRODUCTS

2.1 GENERAL DESIGN SPECIFICATIONS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 All products to have CRN registration numbers.

- .2 Valve Materials
 - .1 Bronze: to ASTM B62 (406F / 208C) or B61 (550F / 288C) as applicable.
 - .2 Brass: to ASTM B283 C3770.
 - .3 Cast Iron: to ASTM A126, Class B (353F / 178C) at 125 PSIG.
 - .4 Forge Steel: to ASTM A105N (800F / 427C)
 - .5 Cast Steel: to ASTM A216WCB (800F / 427C)
- .3 Valve Markings
 - .1 All pressure ratings, manufacturers trademark and size to conform as per MSS-SP-25.
- .4 End Connections:
 - .1 Threaded ends to: ASME B1.20.1
 - .2 Solder ends to: ASME B16.18
 - .3 Flanged ends to: ASME B16.1 (Class 125)
 - .4 Face To Face dimensions to: ASME B16.10
 - .5 Fanged ends to: ASME B16.5
 - .6 Butt Weld Ends to: ASME 16.25
 - .7 Socket Weld Ends to: ASME B.16.11
 - .8 EZ Press – STANDARD
- .5 Testing & Design:
 - .1 MSS-SP-80 - Bronze, Gate & Check Valves.
 - .2 MSS-SP-110 - Ball Valves.
 - .3 MSS –SP-70, 85, 71 - Cast Iron Gate, Globe & Check Valve.
 - .4 MSS-SP-72 - American Valve
 - .5 MSS-SP-67 – Kitz, Toyo, Demco & WKM E, Butterfly Valves.
 - .6 API 602 – Forge Steel Valves (Design)
 - .7 API 598 – Cast Steel Valves, Forge Steel Valves Testing)
 - .8 API 609 – WKM High Performance BFV
 - .9 API 600 – Cast Steel Valves (Design)
- .6 Lockshield Keys:
 - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.

2.2 DOMESTIC WATER SYSTEMS (HOT AND COLD) (LEAD FREE) UP TO 200PSIG.

- .1 Check Valves – Back Flow Prevention
 - .1 For sizes 50 mm (2”) and under, use 860 kPa (125 psig) / 200 W.O.G. bronze body to ASTM C89530 (Lead Free Bronze), Screwed Cap C49300 (Lead Free Brass), Integral Seat, PTFE Disk.
 - .1 Swing “Y” Pattern
 - 1. Screwed Ends - Kitz 822T
 - 2. Solder Ends - Kitz 823T
 - .2 Spring LoadedCDD
 - 1. Screwed Ends – Mueller Steam Specialty Model 303HT 316 SS Body and 316 SS Trim
 - .2 For sizes 65 mm (2-1/2”) and over, use Class 150 Stainless Steel A351 CF8M Body, Trim #10, Bolted Cover, PTFE Gasket, Flanged.
 - .1 Swing Check Flanged
 - 2. Kitz 150 UOAM
 - .2 Wafer Checks
 - .1 Single Flapper
 - Moygro W15A-666 Stainless Steel A351 CF8M Body, Class 150, 316 SS Trim

- .2 Double Door
 - Mueller Steam Specilty Model 72HHHTH Stainless Steel A351 CF8M Body, Class 150, 316 SS Trim
- .3 Silent Check – Spring Loaded Stainless Steel A351 CF8M Body, Class 150, 316 SS Trim, Center Guided
 - Mueller 101MHT
 - Mueller 105MHT (Globe Style)
- .3 Note: Check valves minimum installation 8-10 pipe diameters downstream of pumps is recommended.
- .2 Ball Valves - For Isolation and Balancing Service
 - .1 For sizes 50 mm (2") and under, use 1034 kPa (150 psig) / 600 W.O.G., Brass Body to ASTM C49300 (Lead Free Brass), Full Port, PTFE Seats, Double "O" Ring or Teflon packing, TEA Plated Forged Brass C49300 Vented Solid Ball, Blowout Proof Stem, NSF 61, Lever Handle.
 - .1 Screwed Ends
 - 1. Kitz 858
 - .2 Solder Ends
 - 2. Kitz 859
 - .2 For sizes 65 mm (2-1/2") and over, Use Class 150 Stainless Steel A351 CF8M Body, SS Ball & Stem, PTFE packing, Hypatite or PTFE seats, locking lever operated (Use gear operated for 8" & 10")
 - .1 Kitz 150UTBZM (Full Port)
 - .2 Kitz 150UTAM (Reduced Port)
 - .3 MAS F-150-SS-F-N (Full Port)
 - .4 MAS F-150-SS-R-N (Reduced Port)
 - .3 Option: Sizes 2" to 8", Epoxy Coated Cast Iron Body Flanged, Teflon Fused solid Ball, Full Port Rated 200W @ 200F Class VI positive shutoff, 100% Lead Free Ansi NSF 61-8.
 - .1 American Ball valve Model #3700
 - .4 Cast Iron Grooved Connections from 3" to 6"
 - .1 American Ball valve Model# 3700V
- .3 Butterfly Valves – For Isolation and Balancing Service
 - .1 For sizes 305 mm (12") and smaller, iron body with 2" extended neck to allow for insulation, lug type having bi-directional pressure rating of 1034 kPa (150 psi). Stem shall be of stainless steel with top and bottom bushings of dissimilar materials with positive stem retention mechanism. Valve shall have Stainless Steel disc and molded or bonded style EPDM seat. Valve shall be capable of providing bi-directional "Dead End Service" at full rated pressure with the down stream flanged removed. Valve is suitable for both chilled water and hot water operation. Valve is manufactured in accordance to MSS-SP-67, MSS-SP-25 and API-609.
 - .1 Kitz 6141-EL
 - .2 MAS D&S Series
 - .2 Provide lever on sizes 50 mm (2") to 100 mm (4").
 - .3 On valves 150 mm (6") and over use manual gear operators. Gear operators to be permanently lubricated, self locking, with large size position indicator.

2.3 HEATING & COOLING UP TO 150PSIG

- .1 Gate Valves (Isolation Services).
 - .1 Up to 50mm (2")
 - .1 860KPA (125psig) / 200 WOG Rating, Bronze Body to ASTM – B62 Solid Wedge Disc, Bronze Trim
 - .1 Non- Rising Stem
 - 1. Soldered:

- *Kitz 41*
 - *Toyo 281*
 - 2. Threaded:
 - *Kitz 40*
 - *Toyo 280*
 - .2 Rising Stem
 - 1. Soldered:
 - *Kitz 44*
 - 2. Threaded:
 - *Kitz 24*
 - *Toyo 293*
- 1. 65MM (2 ½") & Over.
 - 1. 860KPA (125psig) /200WOG Rating Cast Iron Body To ASTM A126 Class B, Bronze Trim, OS &Y, Flanged.
- .2 Rising Stem:
 - *Kitz 72*
 - *Toyo 421*
 - 1. Non-Rising Stem:
 - *Kitz 75*
 - *Toyo 415*
- .3 Globe Valves (Throttling Service).– (LOCK SHIELDS AVAILABLE)
 - 2. Up to 50MM (2").
 - 1. 860KPA (125psig) / 200WOG Rating Bronze Body to ASTM B62, Rising Stem, Bronze Disc.
 - 1. Soldered:
 - *Kitz 12*
 - *Toyo 212A*
 - 2. Threaded:
 - *Kitz 11*
 - *Toyo 211A*
 - 2. Composition Disc (Teflon)
 - 1. Soldered:
 - *Kitz 10*
 - 2. Threaded:
 - *Kitz 03*
 - *Toyo 220*
 - 3. 65MM (2 ½") & Over.
 - 1. 860KPA (125psig) / 200WOG Rating Cast Iron Body To ASTM A126, Bronze Trim, OS & Y, Flanged.
 - 1. Rising Stem:
 - *Kitz 76*
 - *Toyo 400A*
- .4 Check Valves (Backflow Prevention) Horizontal & Vertical Service.
 - 4. Up to 50MM (2").
 - 1. 860KPA (125psig) / 200 WOG Rating Bronze Body to ASTM B62, Bronze Trim, and Y Pattern.
 - 1. Y – Pattern Swing
 - 1. Soldered:
 - *Kitz 23*
 - *Toyo 237*
 - 2. Threaded:

- Kitz 22
- Toyo 236
- 2. Spring Loaded Checks⁽¹⁾
 - 1. Soldered:
- Kitz 26
- 2. Threaded:
- MAS 700
- Kitz 36

(1): DUE TO RUBBER MATERIAL LIMITATIONS, NOT TO EXCEED 80C . * NOT TO BE USED ON
RECIPROCATING PUMP SERVICE. *

- 5. 65MM (2 ½") & Over
 - 1. 860KPA (125psig) /200WOG Rating Cast Iron Body, To ASTM A126 Bronze Trim, Bolted Bonnet, Flanged.
 - 1. Flanged:
 - Kitz 78
 - Toyo 435A
 - 2. Wafer Checks
 - 1. Single Flapper
 - 1. 860KPA (125 psig)/200 WOG Rating Cast Iron Body, 316 S.S Trim with Viton –A Seat Ring.
 - Single Flapper Moygro W12A-16V
 - 2. Double Door Check Valve
 - 1. 860KPA (125 psig) / 200 WOG Rating Cast Iron Body, Bronze Trim, BUNA Seat, Double Disc Assembly.
 - Mueller 71AHB3H
 - Mueller 74G (Grooved Mueller Locxend)
 - 3. Silent Check
 - 1. Cast Iron Body, Bronze Trim, EPDM Seat, Spring Loaded Center Guided Disc.
 - Mueller: *101MAP
 - Mueller: *105MAP (Globe Style)

NOTE: WAFER CHECKS A MINIMUM INSTALLATION POINT OF 8 PIPE DIAMETERS DOWNSTREAM OF PUMPS IS RECOMMENDED.

NOTE: SILENT CHECKS ARE NOT RECOMMENDED FOR USE WITH RECIPROCATING PUMPS.

- 2. Ball Valves (Isolation and Balancing):
 - 1. Up to 50MM (2").
 - 1. 1034 KPA (150psig) / 600WOG Rating Brass and or Bronze Body, Full Port, TFE Seats, Double O-Ring Design, or Teflon Packing, Chrome Plated Solid Bronze Ball, Lever Handle.
 - 1. Soldered:
 - Kitz 59
 - Toyo 5049A
 - MAS B2F
 - MMAS B4
 - MAS BZ-4 ⁽²⁾
 - 2. Threaded:
 - Kitz 58
 - Toyo 5044A
 - MAS B1F
 - MAS B3
 - MAS BZ-3 ⁽³⁾

(2) Note: Heavy Pattern – Bronze Body

- 3. EZ-Press – 200WOG – Max.:

- Female Ends – RWV#5020
 - Male Ends – RWV#5023
2. Ball Valve Options:
1. Locking Handles:
 1. Soldered:
 - Kitz 69A-LL
 - Toyo 5043A
 - MAS B-4- LL
 - MAS B-4-SS-LL
 2. Threaded:
 - Kitz 68A- LL
 - Toyo 5041
 - MAS B-3 –LL
 - MAS B-3-SS-LL
 2. Stem Extensions:
 1. Soldered:
 - Kitz 59SE
 - Toyo 5049SE
 2. Threaded:
 - Kitz 58SE
 - Toyo 5044SE
 3. Stainless Steel Ball & Stem:
 1. Soldered:
 - Kitz 69AM-LL (Note Lever Lock)
 - MAS B-4-SS-LL
 - Toyo 5043S
 - MAS BZ-4-SS (BRONZE)
 2. Threaded:
 - Kitz 68AM-LL
 - MAS B-3-SS-LL
 - Toyo 5041S
 - MAS BZ-3-SS-250 (BRONZE)
 4. Balancing (Memory Stop):
 1. Soldered:
 - Kitz 59MS
 - Toyo 5049MS
 - MAS B-4MS
 2. Threaded:
 - Kitz 58MS
 - Toyo 5049MS
 - MAS B-3MS
 5. Wing Handles:
 1. Soldered:
 - Kitz 59W
 - Toyo 5049W
 - MAS B4W
 2. Threaded:
 - Kitz 58W
 - Toyo 5044W
 - MAS B3W
 6. Drain Ports:
 1. Soldered:

- Kitz 69AD
- MAS B4D
- 2. Threaded:
 - Kitz 68AD
 - MAS B3D
- 7. Compression End Service:
 - MAS B5C
- 8. Pex End (In Floor Heating):
 - MAS B-1 PEX
 - MAS B-1D Pex (Drain)
 - MAS B-2Pex (Copper x Pex)
 - RWV 5070 (EZ-Grip)
- 9. Cap & Chain:
 - 1. Soldered:
 - Kitz 69AC
 - 2. Threaded:
 - Kitz 68AC
 - Toyo 5046

3. Butterfly Valves (Isolation & Balancing)(In Lieu of Gate Valves):

1. 65MM (2 ½") & Over.
 1. 1380 KPA / 200WOG Rating Butterfly valves shall be lugged type, Cast or Ductile iron body, aluminum bronze disc EPDM liner, stainless steel stem. Valve shall be have bubble tight shut-off to 200PSI when down stream flange is removed (Full dead-end service). Valves 150MM (6") and smaller shall have lever operator, valves 200MM (8") and larger shall have Manuel Gear operator.
 1. Lug:
 - Kitz 6122 EL
 - Kitz 6122EG
 - Toyo 918BESL
 - Toyo 918BESG
 - WKM E Series
 - MAS D&S Series
 2. Wafer:
 2. Kitz 5122EL
 3. Kitz 5122EG
 4. Toyo 917BESL
 5. WKM E Series
 6. MAS D&S Series
 7. Butterfly Options:
 1. Locking Handle
 2. Infinite Positioning
 3. 3 Way "T" Assemblies
 4. Automation Packages – Electric/ Pneumatic
 5. Modulating /On/Off
 6. Assembled & Tested

B. HEATING AND COOLING 151PSIG TO 250PSIG

1. Gate Valves (Isolation Services).
 1. Up to 50mm (2")
 1. 1034KPA (150psig) / 300 WOG Rating, Bronze Body to ASTM – B62 Solid Wedge Disc, Bronze Trim

1. Non- Rising Stem
 1. Soldered:
 - *Kitz 64*
 2. Threaded:
 - *Kitz 46*
 - *Toyo 204*
 2. Rising Stem
 1. Soldered:
 - *Kitz 43*
 2. Threaded:
 - *Kitz 42*
 - *Toyo 298*
 2. 65MM (2 ½") & Over.
 1. Class 150, Carbon Steel A216WCB Body, Bolted Bonnet, OS&Y, ½ Stellite Trim (Trim #8), Graphite Packing.
 - *KITZ 150 SCLS (Flanged)*
 - *KITZ W150 SCLS (Butt Weld).*
 - *BERIC 101-RF-AA08-H (Flanged)*
 - *BERIC 101-BW-AA08-H (Butt Weld)*
 2. Globe Valves (Throttling Service).– (LOCK SHIELDS AVAILABLE)
 1. Up to 50MM (2").
 1. 1034KPA (150psig) / 300WOG Rating Bronze Body to ASTM B62, Rising Stem, Composition Disc (Teflon)
 1. Soldered:
 - *Kitz 10*
 2. Threaded:
 - *Kitz 09*
 - *Toyo 221*
 2. 65MM (2 ½") & Over.
 1. Class 150, Carbon Steel A216WCB Body, Bolted Bonnet, OS&Y, ½ Stellite Trim (Trim #8), Graphite Packing.
 - *KITZ 150 SCJS (Flanged)*
 - *KITZ W150SCJS (Butt Weld)*
 - *BERIC 201-RF-EA08-H (Flanged)*
 - *BERIC 201-BW-EA08-H (Butt Weld)*
 3. Check Valves (Backflow Prevention) Horizontal & Vertical Service.
 1. Up to 50MM (2").
 1. 1034KPA (150psig) / 300 WOG Rating Bronze Body to ASTM B62, Bronze Trim, and Y Pattern.
 1. Y – Pattern Swing
 1. Soldered:
 - *Kitz 30*
 2. Threaded:
 - *Kitz 29*
 2. Spring Loaded Checks⁽¹⁾
 1. Soldered:
 - *Kitz 26*
 2. Threaded:
 - *Kitz 36*
- (1): NOT TO BE USED ON RECIPROCATING PUMP SERVICE. *
2. 65MM (2 ½") & Over
 1. Class 150, Carbon Steel A216WCB Body, Bolted Cover, ½ Stellite Trim (Trim #8),

Stainless Steel Inserted Flexible Graphite Gasket.

- KITZ 150 SCOS (*Flanged*)
- KITZ W150SCOS (*Butt Weld*)
- BERIC 301-RF-EA08-X (*Flanged*)
- BERIC 301-BW-EA08-X (*Butt Weld*)

2. Wafer Checks

1. Single Flapper

1. Class 150, Cast Steel, ASTM A216WCB Body, 316 S.S. Trim and Disc.

- Single Flapper *Moygro W15A C66*

2. Double Door Check Valve

1. Class 150, Cast Steel ASTM A216WCB Body, 316 S.S. Trim and Disc.

- Mueller 72 *DHH-H-H*

3. Silent Check

1. Cast Steel ASTM A216WCB Body, 316 S.S. Trim and Spring Loaded Center Guided Disc.

- **Mueller:** *101 MDT
- **Mueller:** *105MDT (*Globe Style*)

NOTE: WAFER CHECKS A MINIMUM INSTALLATION POINT OF 8 PIPE DIAMETERS DOWNSTREAM OF PUMPS IS RECOMMENDED.

NOTE: SILENT CHECKS ARE NOT RECOMMENDED FOR USE WITH RECIPROCATING PUMPS.

4. Ball Valves (Isolation and Balancing):

1. Up to 50MM (2").

1. 1034 KPA (150psig) / 600WOG Rating Brass and or Bronze Body, Full Port, TFE Seats, Double O-Ring Design, or Teflon Packing, Chrome Plated Solid Bronze Ball, Lever Handle.

1. Soldered:

- Kitz 59
- Toyo 5049A
- MAS B2F
- MMAS B4
- MAS BZ-4 ⁽²⁾

2. Threaded:

- Kitz 58
- Toyo 5044A
- MAS B1F
- MAS B3
- MAS BZ-3 ⁽³⁾

(2) Note: Heavy Pattern – Bronze Body

3. EZ-Press – 200WOG – Max.:

- Female Ends – RWV#5020
- Male Ends – RWV#5023

2. Ball Valve Options:

1. Locking Handles:

1. Soldered:

- Kitz 69A-LL
- Toyo 5043
- MAS B-4- LL
- MAS B-4-SS-LL

2. Threaded:

- Kitz 68A- LL
- Toyo 5041

- MAS B-3 –LL
- MAS B-3-SS-LL
- 2. Stem Extensions:
 - 1. Soldered:
 - Kitz 59SE
 - Toyo 5049SE
 - MAS B-4SE
 - 2. Threaded:
 - Kitz 58SE
 - Toyo 5044SE
 - MAS B-3SE
- 3. Stainless Steel Ball & Stem:
 - 1. Soldered:
 - Kitz 69AM-LL (Note Lever Lock)
 - MAS B-4-SS-LL
 - Toyo 5043S
 - MAS BZ-4-SS (BRONZE)
 - 2. Threaded:
 - Kitz 68AM-LL
 - MAS B-3-SS-LL
 - Toyo 5041S
 - MAS BZ-3-SS-250 (BRONZE)
- 4. Balancing (Memory Stop):
 - 1. Soldered:
 - Kitz 59MS
 - Toyo 5049MS
 - MAS B-4MS
 - 2. Threaded:
 - Kitz 58MS
 - Toyo 5049MS
 - MAS B-3MS
- 5. Wing Handles:
 - 1. Soldered:
 - Kitz 59W
 - Toyo 5049W
 - MAS B4W
 - 2. Threaded:
 - Kitz 58W
 - Toyo 5044W
 - MAS B3W
- 6. Drain Ports:
 - 1. Soldered:
 - Kitz 69AD
 - MAS B4D
 - 2. Threaded:
 - Kitz 68AD
 - MAS B3D
- 7. Cap & Chain:
 - 1. Soldered:
 - Kitz 69C
 - 2. Threaded:

- Kitz 68C
- Toyo 5046

5. Butterfly Valves (In Lieu of Gate Valves):

1. 65MM (2 ½") & Over.
 1. Class 150, Lug style (285 psig, 2" to 12") 200 psig. dead end service only, with the down stream flanged removed. Ductile iron body, aluminum disc bronze disc, EPDM liner, and stainless steel stem.
 1. Lever up to 6":
 - *Demco # NE Series 222xx-5-114351*
 - 2. 8" and over gear:
 - *Demco # NE Series 222xx-5-11435A*

6. High Performance Butterfly Valves in Lieu of Gate Valves:

1. 65MM (2 ½") & Over.
 1. Class 150, Lug Style, Carbon Steel Body, 17-4 Shaft, S.S Disc, RTFE Packing & Seat. Valve shall be (BI- Directional), Bubble Tight Shut-off to the full ASME Rating, with down stream flanged removed.
 1. Lever up to 6":
 - *WKM Model# B5113 – 02 – SO2 - 11-HL.*
 - 2. 8" and over gear:
 - *WKM Model# B5113 – 02 – S02 – 11 –WG*

C. SPECIALITIES

1. Strainers

1. For sizes 50 mm (2") and under, use Class 600 Stainless Steel Body, Bolted Cover, Y-Pattern, S.S Screen with 1/32 Perforation
 1. Socket Weld - Mueller 582SS
 2. Threaded - Mueller 581SS
2. For sizes 65 mm (2-1/2") to 250 mm (10"), use Class 150, Stainless Steel Body, Bolted Cover, Y-Pattern, S.S. Screen with 1/32 Perforation, Flanged.
 1. Flanged - Mueller# 781-SS

2. Circuit Balancing Valves (Manual Balance with Manual Shut-off Valve:)

1. Valves shall be a Y Pattern globe style design of forged Lead Free DZR Brass, rated at 300W.O.G. non shock. Valve shall have PTFE Disc gasket, EPDM O-ring seals. ABS Plastic Handwheel and Top set Housing, Integral memory stop, Integrated union ends, Pressure/temperature readout ports. Fixed Orifice design. Valves shall provide precise flow metering with accuracy of +_3% and positive shut-off.
 1. Model# Redwhite #9517AB (Threaded)
 2. Redwhite #9519AB (Soldered)

3. EXECUTION

A. INSTALLATION

1. Install rising stem valves in upright position with stem above horizontal.
2. Remove internal parts before soldering.
3. Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

1.2 RELATED SECTIONS

- .1 Section 21 05 01 - Common Work Results for Mechanical
- .2 Section 23 05 05 - Installation of Pipework.

1.3 REFERENCES

- .1 Conform to relevant ANSI, ASME, ASTM, Factory Mutual (FM), and ULC requirements.

1.4 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP 58. ASME B31.1.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
- .2 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .3 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1, ULC C203 and MSS SP 58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- .3 Set inserts in position in advance of concrete work.
- .4 Support all equipment and piping from structural members. Where structural supports do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide supplementary structural members. Obtain approval before using expansion shields. Use minimum two shields for each hanger. **Do not suspend from metal deck.** Anchoring of piping and equipment shall be to manufacturers recommendations. Provide special supports for equipment where required, fabricated from welded steel structural members. Provide shop drawings and obtain their approval when requested.
- .5 Use the smallest pipe size to determine spacing between pipe rack supports.
- .6 Support plumbing piping in accordance with the more stringent requirements of authorities having jurisdiction, plumbing code, or as specified above.
- .7 Place support within 300mm of each horizontal elbow and within 600mm of each side of valve or tee.
- .8 On uninsulated copper piping, use copper hangers or 6mm lead crimped to hanger between copper and ferrous hanger.
- .9 Offset hanger pipe and structural attachments in such a manner that rod is vertical when piping is hot and equalize loads on all hangers where possible.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping 50mm maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut.
 - .2 Cold piping 65mm or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washer.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping 50mm maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .2 Cold piping 65mm or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut.
- .4 Upper attachment to concrete:
 - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS

SP 69.

- .5 Hanger rods: threaded rod material to MSS SP 58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .6 Adjustable clevis: material to MSS SP 69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
- .7 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 69.
- .8 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A 563.
 - .1 Finishes for steel pipework: black or galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: epoxy coated.
- .9 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 69.

2.3 RISER CLAMPS

- .1 Steel or cast-iron pipe: galvanized or black carbon steel to MSS SP 58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.
- .3 Bolts: to ASTM A 307.
- .4 Nuts: to ASTM A 563.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping (Fluid Operating Temperature Range <4 deg. C to 15 deg. C):
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping Fluid Operating Temperature Range 20 deg. C to 175 deg. C)
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.

2.5 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A 125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops.
- .4 Steel alloy springs: to ASTM A 125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations.
- .2 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .3 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .5 Use approved constant support type hangers where:
 - .1 vertical movement of pipework is 13 mm or more,
 - .2 transfer of load to adjacent hangers or connected equipment is not permitted.
- .6 Use variable support spring hangers where:
 - .1 transfer of load to adjacent piping or to connected equipment is not critical.

- .2 variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

- .1 Support plumbing piping in accordance with the more stringent requirements of authorities having jurisdiction, plumbing code, or as specified above.
- .2 Copper piping: up to 15mm: every 1.5 m.
- .3 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .4 Within 300 mm of each elbow.

Maximum Pipe Size:	Maximum Spacing Steel	Maximum Spacing Copper
up to 32mm	2.1 m	1.8 m
40mm	2.7 m	2.4 m
50mm	3.0 m	2.7 m
65mm	3.6 m	3.0 m
80mm	3.6 m	3.0 m
95mm	3.9 m	3.3 m
100mm	4.2 m	3.6 m
150mm	5.1 m	
200mm	5.7 m	

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
- .1 Ensure that rod is vertical under operating conditions.
- .2 Equalize loads.
- .2 Adjustable clevis:
- .1 Tighten hanger load nut securely to ensure proper hanger performance.
- .2 Tighten upper nut after adjustment.
- .3 C-clamps:
- .1 Follow manufacturer's recommended written instructions and torque values when tightening

C-clamps to bottom flange of beam.

- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.
- END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.2 REFERENCES

- .1 Conform to relevant CAN/CGSB requirements.

1.3 SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Equipment Identification
 - .1 Manufacturer's Nameplates:
 - .1 Provide on each piece of equipment a metal nameplate, mechanically fastened with raised or recessed letters.
 - .2 Include registration plates (e.g. pressure vessel, UL and ASME 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.

2.2 SYSTEM NAMEPLATES

- .1 System Nameplates:
 - .1 Provide laminated plastic plates with black face and white centre of minimum size 80mm x 40mm x 1.6mm nominal thickness, engraved with 6mm high lettering. Use 25mm high lettering for major equipment.

- .2 Fasten nameplates securely in conspicuous place. Where nameplates must be mounted on a hot surface, provide standoffs.
- .3 Identify equipment type and number (e.g. ERV-1) and service or areas or zone of building served (e.g. Room S100).
- .4 Submit list of system nameplates to Consultant for review prior to engraving.
- .5 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .6 Sizes: Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

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

- .2 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size # 9.

2.3 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural Gas: to CSA B149.1.
 - .2 Sprinkler Systems: to NFPA 13.

2.4 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Do colour coding for piping identification to ANSI Standard A13.1, and local standards.
- .3 Identify piping with colour coded bands only, unless painting of piping with primary colour is noted below.
- .4 Identify medium in piping with markers showing name and service including temperature and pressure and directional flow arrows where relevant.
- .5 Apply primary colour bands in exposed areas only, on finished piping surfaces, including secondary colour bands to indicated type and degree of hazard.
- .6 Manufactured Pipe Markers and Colour Bands:
 - .1 Provide plastic coated cloth material with protective overcoating and waterproof contact

- adhesive undercoating, suitable for continuous operating temperature of 150°C and intermittent temperature of 205°C. Apply to prepared surfaces.
- .2 Apply 50mm wide tape single wrap around pipe or pipe covering with ends overlapping one pipe diameter but not less than 1" for colour bands.
 - .3 Use block capital letters 50mm high for pipes of 80mm nominal and larger O.D. (including insulation) and not less than 20mm high for smaller diameters. Use black lettering on yellow and orange primary colour background and white lettering for all other background colours.
 - .4 Use direction arrows 150mm long by 50mm wide for piping of 80mm nominal or larger O.D. including insulation and 100mm long by 20mm wide for smaller diameters. Use double headed arrows where direction of flow is reversible.
 - .5 Use waterproof and heat resistant plastic marker tags for pipes and heat resistant plastic marker tags for pipes and tubing of 20mm nominal and smaller O.D.
 - .6 In general, use black pipe marker direction arrows. Use white on red background for fire protection pipe markers.
 - .7 Standard of Acceptance:
 - .1 W.H. Brady identification tapes, bands, markers; Seton Name Plate Corporation, Setmark pipe markers.
 - .7 Location of identification:
 - .1 Locate markers and classifying colour bands on piping systems so they can be seen from floor or platform.
 - .2 Identify piping runs at least once in each room.
 - .3 Do not exceed 9m between identifications in open areas
 - .4 Identify both sides where piping passes through walls, partitions and floors.
 - .5 Where piping is concealed in a pipe chase or other confined space, identify at point of entry and leaving, and at each access opening.
 - .6 Identify piping at major manual and automatic valves immediately upstream of valves. Where this is not possible, place identification as close to the valve as possible.
 - .7 Identify branch, equipment or building served after such valve.
 - .8 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
 - .9 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
 - .10 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
 - .11 Submit legends with colour classifications to Consultant for review before ordering material where colours differ from following table:
 - .1 Pipe and Valve Identification

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

- .2 Background colour marking and legends for piping systems:

Pipe Marker Legend	Valve Tag Legend	Primary Colour	Secondary Colour
Dom. Cold Water	Dom. Cold Water	Green	None
Dom. Hot Water Supply	Dom. Hot Water Supply	Green	None
Dom. Hot Water Recirc.	Dom. Hot Water Recirc.	Green	None
Sprinklers	Sprinkler	Red	White
Fire Protection	F.P.W.	Red	White
San. Sewer	San. Sewer	Green	None
Vent	Vent	Yellow	Black
Storm Sewer	St. Sewer	Green	None
Glycol Hot Water Supply	GHWS	Yellow	Black
Glycol Hot Water Return	GHWR	Yellow	Black
Refrigeration Suction	Ref. Suction	Yellow	None
Refrigeration Liquid	Ref. Liquid	Yellow	None

2.5 IDENTIFICATION DUCTWORK SYSTEMS

- .1 Ductwork Identification
 - .1 Use 50mm high black stenciled letters with directional flow arrow
 - .2 Identification to be as per the HVAC drawings as follows:
 - .1 Fresh Air
 - .2 Exhaust Air
 - .3 Supply Air
 - .4 Return Air
 - .3 Do not exceed 9m maximum distance between markings.
 - .4 Identify ducts each side of dividing walls or partitions and beside each access door.
 - .5 Stencil over final finish only.

2.6 VALVES, CONTROLLERS

- .1 Valves and Controllers Identification
 - .1 Provide brass tags with 15mm stamped code lettering and numbers filled with black paint. Secure with non-ferrous chains or "S" hooks. Use for all valves and operating controllers.
 - .2 Provide Consultant with six identification flow diagrams 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.
 - .3 Mount, where directed, one copy of flow diagram and schedule mounted in glazed frame. Provide one copy in each maintenance instruction manual.
 - .4 Consecutively number valves in systems.
 - .5 Coordinate between the various mechanical sections to prevent overlapping of numbering systems.

2.7 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

2.8 LANGUAGE

- .1 Identification in English.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 TIMING

- .1 Provide identification only after painting specified Section 09 91 23 - Interior Painting has been completed.

3.3 INSTALLATION

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

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 30 ft intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.

- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, garbage, tools and equipment.

END OF SECTION

PART 1 GENERAL SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.
- .3 TAB shall be completed for all HVAC Units, air-handling units, energy recovery units, make-up air units, Desiccant Dehumidification Units, exhaust fans, Refrigeration (Ice Rink) Glycol Piping, Chiller, Cooling Tower, Cooling Tower Pumps, Heat Exchangers, Glycol pumps, Heat Recovery System (Domestic Water / Zamboni Water Preheat), Domestic Hot Water Recirculation and all associated control valves, circuit balancing valves etc. to make a complete and operational mechanical system.

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 The TAB agency shall be a certified member of one of the following to perform TAB service for HVAC and water balancing of systems and of equipment:
 - .1 Canadian Associated Air Balance Council (CAABC)
 - .2 Associated Air Balance Council (AABC)
 - .3 Testing, Adjusting and Balancing Bureau (TABB)
 - .4 National Environmental Balancing Bureau (NEBB)
 - .5 The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the Contractor shall immediately notify the Consultant and submit another qualified TAB firm for approval. Any agency that has been the subject of disciplinary action by either the CAABC, AABC, TABB or NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.
- .2 TAB Specialist: The TAB specialist shall be either a member of CAABC, AABC or TABB or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein.
- .3 Provide documentation confirming qualifications, successful experience. TAB contractor shall have a minimum of 5 (five) years experience.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

- .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
- .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (CAABC, AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Engineer for verification of TAB reports.

1.9 START OF TAB

- .1 Notify Engineer 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Application of weatherstripping, sealing, and caulking.
- .5 Pressure, leakage, other tests specified elsewhere Division 23.
- .6 Provisions for TAB installed and operational.
- .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Access doors, installed, closed.
 - .7 Outlets installed, volume control dampers open.
 - .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

- .1 Measure and adjust all HVAC (Outside Air, Exhaust air, Supply air, Return Air, etc.) systems to conform within 5% of specified requirements and arrange and pay for all changes to drive sheaves and belts to meet these requirements. Adjust individual outlets for desired air pattern. Carry out tests under maximum conditions, where practicable.
- .2 Carry out complete adjustment of water flow rates associated with each part of the HVAC systems. This includes such systems as glycol hot water, chilled water, heat recovery system, cooling towers, domestic water recirculation. Record final flow rates in each case plus operating pressures and temperatures at full load conditions.

1.11 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 2 % of actual values.

1.12 INSTRUMENTS

- .1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

- .2 Calibrate within 3 months of TAB.

1.13 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Engineer, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.15 TAB REPORT

- .1 Properly record all final results, together with all pertinent data, such as temperatures, pressures, motor loads, alignment, belt condition, etc., for each piece of equipment. Deliver 4 copies to the Consultant. On approval, 2 copies will be returned for inclusion in the Maintenance Manuals.
- .2 Follow SMACNA or AABC Standards.
- .3 Include the following for all systems:
 - .1 Installation data:
 - .1 Manufacturer and model size, discharge arrangement and class, motor type, HP, voltage, phase, cycles, full load amps, location, and local identification data.
 - .2 Design data:
 - .1 Total cfm, static pressure, motor HP, rpm, amps, outside air cfm, fan rpm, and fan bhp.
 - .3 Fan data:
 - .1 cfm, static pressure, fan rpm, motor operating amps, motor bhp.
 - .4 Complete air system schematic with design and actual cfm at each outlet or inlet. Show room numbers and floors.
 - .5 Following acceptance of the report, permanently mark settings of all splitters, dampers and other adjustment devices so that adjustment can be restored if disturbed at any time.
 - .6 Pump data:
 - .1 Pump manufacturer's data, motor kw, rated speed and head characteristics, actual performance characteristics including motor amperage and hydraulic head. Include observations with respect to any control difficulties and specific operating characteristics if different from those specified.
 - .7 Balancing Data (Water Systems)
 - .1 Provide flow rate measurements for ALL circuit balancing valves, control valves, pressure bypass valves, pressure sensor settings and flow rates for each piece of mechanical equipment. TAB report MUST provide design flow rates for each fixture and also provide actual balancing valve setting and corresponding flow rates for every fixture. Data must be compiled in a table for easy comparison of design and actual results.
 - .8 Any areas deemed unacceptable and/or do not meet design flow rates shall be adjusted by TAB contractor at no additional cost. Schedule walkthrough with Consultant once balancing is completed. Any additional deficiencies or discrepancies found during walkthrough must be corrected by TAB contractor at no additional cost.

1.16 VERIFICATION

- .1 Reported results subject to verification by Engineer.
- .2 Provide personnel and instrumentation to verify up to 30% of reported results.
- .3 Pay costs to repeat TAB as required to satisfaction Engineer.

1.17 SETTINGS

- .1 After TAB is completed to satisfaction of Engineer, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.18 AIR SYSTEMS

- .1 Do TAB of systems, equipment, components, controls specified Division 23.
- .2 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .3 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
- .4 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.19 HYDRONIC SYSTEMS

- .1 Do TAB of systems, equipment, components, controls etc. for all hot water systems.
- .2 Measurements shall include, at a minimum, the following information:
 - .1 Heat Exchangers, Cooling Towers, Chillers, Ice Rink System
 - Manufacturer and type
 - Model and/or Serial number
 - Design water flow rate
 - Rated water pressure drop
 - Design water temperature in and out
 - Rated heating capacity
 - Measured discharge water pressure
 - Measured inlet water pressure
 - Calculated water pressure drop
 - Measured water temperature in and out
 - Control Valve Reading (pressure drop, control setting, flow rate)
 - Circuit Balancing Valves (Pressure drop, design flow rate, actual flow rate, balancing valve setting)
 - Date and time measurements taken

1.20 POST-OCCUPANCY TAB

- .1 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 1 month of termination of Warranty Period.

PART 2 PRODUCTS

2.1 FIRE DAMPERS

- .1 Test all fire dampers as follows:
 - .1 Make the test by releasing the fusible link and witnessing closure of the damper. Reset upon completion. Leave all fire dampers in the open position. Make a set of white prints to show that each damper has been checked for closure, accessibility, and installation. Submit the prints to the Consultant.
 - .2 Do the balancing process strictly in accordance with the full intent and requirement of the ASHRAE Handbook - Testing, adjusting and balancing chapter.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 The intent is for all Ducts to be constructed, installed and sealed in accordance with Section 23 31 13.01 – Metal Ducts – Low Pressure to 500Pa and Section 23 31 13.02 – Metal Ducts – High Pressure to 2500 Pa. Providing the consultant is satisfied with the quality of the ductwork installation and sealing procedures, Section 23 05 94 – Pressure Testing Air Systems may be reduced. The consultant reserves the right to fully enforce the Section 23 05 94 – Pressure Testing of Air Systems at their discretion.
- .2 Section Includes:
 - .1 Materials and methods for pressure testing ducts over 5 m in length, forming part of a supply, return, outside or exhaust ductwork system directly or indirectly connected to air handling equipment.

1.2 RELATED SECTIONS

- .1 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa

1.3 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 - .1 SMACNA HVAC Air Duct Leakage Test Manual.
- .2 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE Standard 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings

1.4 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
 - .1 Submit proposed report form and test report format to Engineer for approval at least three months before proposed date of first series of tests. Do not start tests until approval received in writing from Engineer.
 - .2 Prepare report of results and submit to Engineer within 24 hours of completion of tests. Include:
 - .1 Schematic of entire system.
 - .2 Schematic of section under test showing test site.
 - .3 Required and achieved static pressures.
 - .4 Orifice differential pressure at test sites.
 - .5 Permissible and actual leakage flow rate (L/s) for test sites.
 - .6 Witnessed certification of results.
 - .3 Include test reports in final TAB report.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Instructions: submit manufacturer's installation instructions.
 - .6 Manufacturer's field reports specified.

1.5 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section.
 - .1 Verify project requirements.
 - .2 Review installation conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review installation instructions and warranty requirements.

PART 2 PRODUCTS

2.1 TEST INSTRUMENTS

- .1 Test apparatus to include:
 - .1 Fan capable of producing required static pressure.
 - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
 - .3 Calibration curves for orifice plates used.
- .2 Test apparatus: accurate to within +/- 2 % of flow rate and pressure.
- .3 Submit details of test instruments to be used to Engineer at least three months before anticipated start date.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 TEST PROCEDURES

- .1 Test all exterior ductwork and representative sections of other pressure ducts totaling 25% of the total system. Sections shall be chosen by the Consultant.
- .2 Test sections minimum of 5m long with inclusive of takeoffs, fittings, branch connections, and/or elbows.
- .3 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .4 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .5 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual and ASHRAE 90.1 Standard requirements.
- .6 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.3 SITE TOLERANCES

- .1 System leakage tolerances for tested sections shall be calculated based on design duct pressure rating for Class A seals as defined in ASHRAE 90.1 and listed in cfm/100ft² duct surface area.

- .2 Testing shall be performed at design duct pressure.
- .3 Leakage tests for all exterior ducts and ductwork designed to operate at static pressure in excess of 750 Pa shall not exceed calculated leakage rate.
- .4 Leakage tests on following ducts shall not exceed calculated tolerances for Class A seal. This requirement, at the Consultants discretion, based on visual inspection of sealing procedures and workmanship, may be waived or reduced to the following:
 - .1 Small duct systems up to 250 Pa: leakage 2%.
 - .2 Large low pressure duct systems up to 500 Pa: leakage 2%.
 - .3 High pressure duct systems, up to 2,500 Pa: leakage 2%
- .5 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.4 TESTING

- .1 Test ducts before installation of insulation or other forms of concealment.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.

3.5 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1.1 SUMMARY

- .1 operate and co-ordinate with the requirements of other units of work specified in other sections.
- .2 This section covers the insulation of the following:
 - .1 Ducts & Plenums Exposed to Outside Air Temperatures
 - .2 Supply Air Ductwork
 - .3 Return/Exhaust Air Ductwork
 - .4 Fireproof Duct Wrap for Kitchen Exhaust
 - .5 Acoustic Duct Liner (Supplied and Installed by Division 23)

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .4 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 PA.

1.3 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 547, Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C 553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C 612, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C 795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
 - .9 ASTM C 921, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701, Thermal Insulation Polyotrene, Boards and Pipe Covering.

1.4 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data for the following:
 - .1 Jacket materials, noting application for each type
 - .2 Ductwork Insulation Types, noting application for each product
 - .3 Finishing cement
 - .4 Lagging adhesive
 - .5 Duct Coverings
- .3 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.6 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

1.7 MANUFACTURERS' INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Installation instructions to include procedures used, and installation standards achieved.

1.8 QUALIFICATIONS

- .1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project.

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.

- .4 Store at temperatures and conditions recommended by manufacturer.

PART 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION & FINSH

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24° C mean temperature when tested in accordance with ASTM C 335.
- .3 Ductwork mounted external to the building envelope:
 - .1 50mm rigid glass mineral wool board faced on one side with foil-crim-kraft (FSK) vapour barrier and with lightweight black glass mat on the airstream side. Min R value of 8. Knauf Eclipse Air Duct Board
 - .2 Provide external all weather, VentureClad Jacketing system – Aluminum Finish
- .4 Acoustic Duct Liner (Supplied and Installed by ductwork contractor):
 - .1 Internal Surfaces (acoustic): 15mm flexible duct liner, fiberglass bonded with thermosetting resin and faced with a black coated mat on the airstream side. Manson Akousti-Liner.
- .5 Ducts & Plenums Exposed to Outside Air Temperatures
 - .1 Ductwork within the Building Envelope exposed to raw exterior air (ie. Outside Air intake/exhaust Ducts, mixing box & Plenums until connection with equipment): a) **Concealed:** For concealed locations, use Manson Alley Wrap B flexible blanket insulation complete with white polypropylene scrim-kraft (PSK) vapour barrier. Min R value of 8 (50mm @ 1.5 PCF) b) **Exposed:** 50mm rigid glass fibre board faced on one side with a white all service jacket (ASJ) vapour barrier. Min R value of 8. Manson AK Board.
 - .2 c) Refer to the equipment specific application table in section 2.3 for the insulation requirements.
- .6 Air Ductwork Insulation:
 - .1 Refer to the equipment specific application table in section 2.3 for the insulation requirements.
 - .2 **Concealed** Ductwork: use Manson Alley Wrap B flexible blanket insulation complete with white polypropylene scrim-kraft (PSK) vapour barrier. Min R value of 3.5 (38mm @ 0.75 PCF)
 - .3 **Exposed** Ductwork: use rigid glass fibre board faced on one side with a white all service jacket (ASJ) vapour barrier. Min R value of 3.5 (25mm @ 3.0 PCF). Manson AK Board.
- .7 Air Ductwork Insulation protective jacketing:
 - .1 Refer to the equipment specific application table in section 2.3 for the jacket requirements.
 - .2 Type A: FlexClad-400 self adhesive system - White
 - .3 Type B: Molded Polyvinyl Chloride (PVC) - White
 - .1 One-piece molded type to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and

- joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
- .8 FIRE RATED DUCT WRAP INSULATION (Kitchen Exhaust Ductwork for NFPA Rated Ductwork):
 - .1 Kitchen Exhaust Grease Ducts: Install fire resistive duct wrap insulation in direct contact with ductwork to Manufacturer's instructions and referenced standards, to applicable Omega Point Laboratories design numbers, including listed penetration firestop system.
 - .2 For kitchen exhaust grease ducts, regardless of fire rating, provide two layers of 3M Fire Barrier Duct Wrap 615+ per layer with 3 inch (76mm) overlaps.
 - .3 3M Fire Barrier Duct Wrap 615+: Lightweight, non-asbestos, high temperature, bio-soluble, calcium-magnesium-silicate (CMS) non-woven blanket, encapsulated in a scrim-reinforced foil, blanket thickness of 1.5 inches (38mm) for ventilation and grease duct applications.
 - .1 Color: White blanket, aluminum foil encapsulated.
 - .2 Weight: 0.9 psf (4.38 kg/m2).
 - .3 Density: 6 pcf nominal.
 - .4 Thermal Conductivity (k-value) at 500 Degrees F (260 Degrees C) (ASTM C411, ASTM C518): 0.48 Btu/(ft2 × h × F) (0.07 W/(m × K)).
 - .5 R-Value per ASTM C 518 at ambient (77 F/ 25 C): at least 6.3 (F-ft²-hr / Btu)
 - .6 Service range up to 2000°F (1093°C)
 - .7 Fire Resistance: For use in 2 hour fire resistant systems.
 - .8 Product complies with ASTM E 2336 test standard.
 - .9 Product complies with ISO 6944 test standard.
 - .10 Through-penetration per ASTM E 814 (UL 1479)
 - .11 Non-combustible per ASTM E 136
 - .4 RELATED DUCT WRAP PRODUCTS
 - .1 Tape:
 - .1 High performance filament tape, 3M No. 898 1 inch (25mm) wide.
 - .2 FSK Facing Tape with aluminum foil, fiberglass scrim, kraft paper backing: nominal 3 inches (76mm) or 4 inches (102mm) wide (for sealing cut blanket edges and seams), 3M No. 3320.
 - .2 Banding Material: Stainless or carbon steel banding: 1/2 inch (13mm) wide X 0.015 inch (0.4mm) thick, as stated in duct wrap Design Listing.
 - .3 Insulation pins and clips:
 - .1 Copper-coated steel pins, 12 gauge with a minimum length of 4 inches (102mm) with square galvanized steel speed clips: 2.5 inch (64mm).
 - .2 12 gauge insulated cup head steel pins.
 - .4 Through-penetration firestop materials:
 - .1 Packing materials: Pieces of 3M Fire Barrier Duct Wrap, or 4 pcf mineral wool.
 - .2 Sealants: 3M Fire Barrier: 1000 NS non-slump silicone sealant, 1003 SL self-leveling silicone sealant, 2000+ premium non-slump silicone sealant, or CP 25WB+ premium intumescent latex caulk, as stated in firestop Design Listing.

2.3 INSULATION APPLICATION TABLE

- .1 Insulation and Jacket Application Table

System	Location	Insulation			Jacket Type	Thickness (mm)	Remarks
		SA	RA	EA/FA			
AHU-1	Interior	yes	no	n/a	n/a	38	
EF-1-7	Interior	n/a	n/a	yes*	n/a	38	*Insulate first 10 ft. of duct from fan.
MAU-1,2	Interior	yes*	yes*	yes*	n/a	38	*Insulate first 10 ft. of duct from unit.
ERV-1	Interior	no	no	yes*	n/a	38	*Insulate first 10 ft. of duct from unit.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.
- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .5 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .6 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .7 Contact adhesive: quick-setting
- .8 Canvas adhesive: washable.
- .9 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .10 Fasteners: 2 mm diameter pins with 35 mm diameter or square clips, length to suit thickness of insulation.

PART 3 EXECUTION

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of ductwork systems complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: At 300 mm on centre in horizontal and vertical directions, minimum two rows each side.
- .7 Supply, Return and Exhaust Air Duct Insulation:
 - .1 Preparation: Fix mechanical fasteners to both horizontal and vertical surfaces at approximately 300mm on centre, each way.
 - .2 Application: Cut insulation with integral vapour barrier to required size and apply to exterior of duct or plenum with vapour barrier on the warm side with horizontal surfaces overlapping vertical surfaces. Butt edges together tightly. Secure insulation by impaling on mechanical fasteners. Where mechanical fasteners penetrate vapour barrier, and at all corners and joints, apply vapour barrier tape or vapour barrier strips adhered with vapour barrier adhesive. Where raised seams are encountered, secure to the seams an overlapping strip of flexible insulating material with integral vapour barrier to provide a continuous vapour barrier.
- .8 Acoustic Duct Liner (Internal)
 - .1 Preparation: Fix mechanical fasteners to both horizontal and vertical surfaces at approximately 300mm on centre each way.
 - .2 Application: Cut insulation material to required size and apply to interior of duct or plenum with horizontal surfaces overlapping vertical surfaces and with edges tightly butted together. Secure insulation by impaling on mechanical fasteners. Where mechanical fasteners penetrate factory finish and at all joints, apply a seal coating. On high velocity duct systems apply reinforcing membrane over the entire insulation surface. Seal off leading edge of insulation to duct surface with reinforced seal coating. Apply acoustic lining to interior of all supply air ducts as indicated on Drawings.
- .9 Fire Rate Duct Wrap for NFPA Rated Kitchen Exhaust
 - .1 Do not begin installation until substrates have been properly prepared.
 - .2 Conduct tests according to manufacturer's written recommendations to verify that substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt and other foreign substances capable of impairing bond of firestopping.
 - .3 Verify that items penetrating fire rated assemblies are securely attached, including sleeves, supports, hangers, and clips.
 - .4 Verify that openings and adjacent areas are not obstructed by construction that would interfere with installation of firestopping, including ducts, piping, equipment, and other suspended construction.
 - .5 Verify that environmental conditions are safe and suitable for installation of firestopping.
 - .6 If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

- .7 PREPARATION
 - .1 Prepare substrates in accordance with manufacturer's instructions and recommendations.
 - .2 Install masking and temporary coverings as required to prevent contamination or defacement of adjacent surfaces due to firestopping installation.
- .8 INSTALLATION – GENERAL
 - .1 Install in strict accordance with manufacturer's detailed installation instructions and procedures.
 - .2 Install so that openings are completely filled and material is securely adhered.
 - .3 Where firestopping surface will be exposed to view, finish to a smooth, uniform surface flush with adjacent surfaces.
 - .4 After installation is complete, remove combustible forming materials and accessories that are not part of the listed system.
 - .5 Repair or replace defective installations to comply with requirements.
 - .6 At each through penetration, attach identification labels on both sides in location where label will be visible to anyone seeking to remove penetrating items or firestopping.
 - .7 Clean firestop materials off surfaces adjacent to openings as work progresses, using methods and cleaning materials approved in writing by firestop system manufacturer and which will not damage the surfaces being cleaned.
 - .8 Notify authority having jurisdiction when firestopping installation is ready for inspection; obtain advance approval of anticipated inspection dates and phasing, if any, required to allow subsequent construction to proceed.
 - .9 Do not cover firestopping with other construction until approval of authority having jurisdiction has been received.
- .9 Firestopping At Fire Separations:
 - .1 Kitchen exhaust grease ducts: Fire resistive duct wrap insulation to be continuous through wall or floor penetrations. Minimum 0.5 inch (13mm), maximum 4.5 inch (114mm) clearance permitted between outer layer of duct wrap insulation and edge of opening. Fill annular space between edge of opening and wrapped duct with pieces of 3M duct wrap insulation or mineral wool insulation firmly packed into opening. Compress to percentage stated and minimum depth stated in firestop listing. Recess packing material below surface on both sides of walls or top side only for floors to depth stated in firestop listing. Seal over packing material using 3M firestop sealant to depth stated in firestop listing, flush with top side of floor and both sides of wall surfaces.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 None

1.2 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.3 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

- .1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2 When systems are operational, perform following tests:
 - .1 Conduct full scale tests at maximum design flow rates, temperatures, and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
 - .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
 - .1 Pump operation.
 - .2 Boiler operation.
 - .3 Control pressure failure.
 - .4 Maximum heating demand.
 - .5 Boiler failure.
 - .6 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

1.4 HYDRONIC SYSTEM CAPACITY TEST

- .1 Perform hydronic system capacity tests after:
 - .1 TAB has been completed
 - .2 Verification of operating, limit, safety controls.
 - .3 Verification of primary and secondary pump flow rates.
 - .4 Verification of accuracy of temperature and pressure sensors and gauges.
- .2 Calculate system capacity at test conditions.
- .3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
- .4 When capacity test is completed, return controls and equipment status to normal operating conditions.
- .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
- .6 Heating system capacity test:
 - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

- .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
- .2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
- .2 Test procedures:
 - .1 Open fully force flow heaters and radiator control valves.
 - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
 - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.
 - .4

1.5 HYDRONIC SYSTEMS

- .1 In addition to procedures specified above, perform following:
 - .1 Add chemicals once per week as required.
 - .2 Perform TAB as specified Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .3 Set up and adjust drip feeders, timer controls, pump strokes as required to maintain required chemical feed rates.

1.6 GASEOUS FUEL SYSTEMS

- .1 Operation tests:
 - .1 Measure gas pressure at gas meter outlet and at burner manifold.
 - .2 Verify details of temperature and pressure compensation at meter.
 - .3 Verify settings, operation, venting of high- and low-pressure cut-outs, alarms.
 - .4 Check terminals of vents for gas pressure regulators.

1.7 POTABLE WATER SYSTEMS

- .1 When cleaning is completed and system filled:
 - .1 Verify performance of equipment and systems as specified elsewhere in Division 23.
 - .2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
 - .3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.
 - .4 Ensure that domestic hot water recirculation system is operational.

1.8 WET AND DRY PIPE SPRINKLER SYSTEM

- .1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 23.
- .2 Verification of controls, detection devices, alarm devices is specified Division 26.
- .3 Verify operation of interlocks between HVAC systems and fire alarm systems.

1.9 SANITARY AND STORM DRAINAGE SYSTEMS

- .1 Buried systems: perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.
- .2 Ensure that traps are fully and permanently primed.

- .3 Ensure that fixtures are properly anchored, connected to system.
- .4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.
- .5 Cleanouts: refer to Section 22 42 00 - Plumbing Fixtures.
- .6 Roof drains:
 - .1 Refer to Section 22 42 00 - Plumbing Fixtures.
 - .2 Remove caps as required.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for piping, valves and fittings for gas fired equipment.

1.2 RELATED REQUIREMENTS

- .1 Section 22 05 01 – Common Work Results for Mechanical
- .2 Section 23 05 05 – Installation of Pipework
- .3 Section 23 05 23 – Valves
- .4 Section 23 05 93 – Performance Verification of Mechanical Piping
- .5 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems

1.3 REFERENCES

- .1 Conform to latest version of CSA B149.1 for supply and installation of natural gas systems.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
 - .2 Indicate on manufacturers catalogue literature following:
 - .1 valves.
 - .2 pipe
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Black steel pipe shall be shipped to the jobsite in such a manner to protect the pipe. The pipe and fittings shall not be roughly handled during shipment. Pipe and fittings shall be unloaded with reasonable care.
- .3 Protect the stored product from moisture and dirt. Elevate above grade. When stored inside, do not exceed the structural capacity of the floor.

- .4 Protect fittings and piping specialties from moisture and dirt.

PART 2 PRODUCTS

2.1 QUALITY CONTROL

- .1 Fittings shall be listed & approved for their intended application.
- .2 All fittings used in Fuel Gas Applications shall be listed by a third-party agency as being acceptable for fuel gas piping systems.

2.2 PIPE

- .1 Steel pipe: to ASTM A 53/A 53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
 - .2 NPS ½ to 2, plain end (Viega Mega Press)
 - .3 NPS2 1/2 and over, plain end.
- .2 Underground natural gas piping to be Polyethylene product manufactured to ASTM D2513. Gastite or equivalent products are acceptable.

2.3 JOINTING MATERIAL

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: nonmetallic flat.
- .4 Cold Press Mechanical Joint Fitting shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria of ANSI/CSA LC4. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have Smart Connect® feature design (leakage path). MegaPress fittings with the Smart Connect feature assure leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

2.4 FITTINGS

- .1 Steel pipe fittings, screwed, flanged or welded:
 - .1 Malleable iron: screwed, banded, Class 150.
 - .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
 - .3 Welding: butt-welding fittings.
 - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A 47/A 47M.
 - .5 Bolts and nuts: to ASME B18.2.1.
 - .6 Nipples: schedule 40, to ASTM A 53/A 53M.
- .2 Cold Press Mechanical Joint Fitting (Megapress):
 - .1 Cold Press Mechanical Joint Fitting shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria of ANSI/CSA LC4. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have Smart Connect® feature design (leakage

path). MegaPress fittings with the Smart Connect feature assure leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

2.5 VALVES

- .1 See Section 23 05 23 Valves.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .2 The installing contractor shall examine the pipe and fittings for defects, sand holes or cracks. There shall be no defects of the pipe or fittings. Any damaged pipe or fittings shall be rejected.
- .3 The installing contractor shall insure that internal components of the cold press mechanical joint press fitting are properly in place and free from damage. This is to include sealing elements, grip ring & separator rings.
- .4 Black steel pipe shall be cut with an approved pipe cutting tool. The pipe shall be cut square to permit proper joining with the fittings.
- .5 Remove scale, slag, dirt and debris from inside and outside of pipe and fittings before assembly. The protective coating shall be removed from the outside of the pipe end and shall be wiped clean and dry. The burrs on the pipe shall be reamed with a de-burring or reaming tool.

3.2 PIPING

- .1 Install in accordance with Section 23 05 01 - Installation of Pipework, applicable Provincial/Territorial Codes, CAN/CSA B149. 1..
- .2 Install drip points:
 - .1 At low points in piping system.
 - .2 At connections to equipment.
- .3 Press Fittings: MegaPress Cold Press Mechanical Joint Fittings shall be installed in accordance with the manufacturer's installation instructions. The protective corrosion coating shall be removed from the outside of the pipe end. The pipe shall be fully inserted into the fitting and the pipe marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the pipe to assure the pipe is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.

3.3 VALVES

- .1 Install valves with stems upright or horizontal.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.
 - .2 See Section 23 05 05 – Installation of Pipework.

3.5 ADJUSTING

- .1 Purging: purge after pressure test in accordance with CAN/CSA B149.1.
- .2 Pre-Start-Up Inspections:
 - .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
 - .2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.6 CLEANING

- .1 Cleaning: in accordance with Section 23 08 02- Cleaning and Start-Up of Mechanical Piping Systems, CAN/CSA B149.1, supplemented as specified.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

PART 1 GENERAL SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for copper tubing and fittings for refrigerant piping of split systems and remote condensing units.

1.2 RELATED REQUIREMENTS

- .1 Section 21 05 01 – Common Work Results for Mechanical
- .2 Section 23 05 05 – Installation of Pipework
- .3 Section 23 05 93 – Performance Verification of Mechanical Piping
- .4 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems

1.3 REFERENCES

- .1 Conform to relevant CSA and Environment Canada regulations.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Pipe shall be shipped to the jobsite in such a manner to protect the pipe. The pipe and fittings shall not be roughly handled during shipment. Pipe and fittings shall be unloaded with reasonable care.
- .3 Protect the stored product from moisture and dirt. Elevate above grade. When stored inside, do not exceed the structural capacity of the floor.
- .4 Protect fittings and piping specialties from moisture and dirt.

PART 2 PRODUCTS

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B 280, type ACR.
 - .2 Annealed copper: to ASTM B 280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

- .1 Brazed:

- .1 Fittings: wrought copper to ASME B16.22.
- .2 Joints: silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.
- .2 Flanged:
 - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
 - .2 Gaskets: suitable for service.
 - .3 Bolts, nuts and washers: to ASTM A 307, heavy series.
- .3 Flared:
 - .1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.4 VALVES

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 GENERAL

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 01 - Installation of Pipework.

3.3 BRAZING PROCEDURES

- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

3.4 PIPING INSTALLATION

- .1 Install as per manufacturer's recommendations.

3.5 PRESSURE AND LEAK TESTING

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.

- .3 Test Procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 07 84 00 - Firestopping.
- .4 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .5 Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .6 Section 23 33 00 – Air Duct Accessories

1.3 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A 480/A 480M-[03c], Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A 635/A 635M-[02], Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A 653/A 653M-[03], Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .4 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-[02], Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-[02], Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 NFPA 96-[01], Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition [1995] and Addendum No. 1, [1997].
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, [1985], 1st Edition.

1.4 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

1.5 QUALITY ASSURANCE

- .1 Certification of Ratings:
 - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Contractor Certification: The Contractor shall certify the following:
 - .1 The products and systems were installed in strict compliance with the specifications, manufacturer's recommendations and all applicable local or state codes.
 - .2 The specified field tests have been satisfactorily performed.
 - .3 The ductwork was protected from dust and debris throughout construction and cleaned in accordance with Section 21 05 01

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.

PART 2 PRODUCTS

2.1 SEAL CLASSIFICATION

- .1 All Ductwork and plenums with a pressure class rating shall be constructed to seal class A in conformance with ASHRAE 90.1.
 - .1 The specific article referenced in ASHRAE 90.1 is 6.4.4.2. Duct Sealing. This is applicable to most ductwork on this project (all ducts connected to a fan system). The pressure class of all duct systems can be read from the external static listed in the associate equipment schedule, and if not provided can be assumed at 1"w.c. An example of a non-pressure class duct would be a transfer duct or cross talk – these can be sealed to Class C. Also refer to section 23 05 94 for the intent for pressure testing of the ducted air system.
- .2 All other ductwork shall be constructed to a seal class C
 - .1 An example of a non-pressure class duct would be a transfer duct or cross talk – these can be sealed to Class C. Also refer to section 23 05 94 for the intent for pressure testing of the ducted air system
- .3 Seal classification:
 - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
 - .2 Class C: transverse joints and connections made air tight with gaskets, sealant, tape], or combination thereof. Longitudinal seams unsealed.

2.2 SEALANT

- .1 Sealant: Low VOC oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

- .2 Pressure sensitive tape shall not be used as the primary sealant, unless it has been certified to comply with UL-181A or UL-181B as per ASHRAE.

2.4 DUCT LEAKAGE

- .1 All ductwork designed to operate at static pressures in excess of 750 PA and all exterior ductwork shall be tested as required by ASHRAE 90.1.
- .2 Duct Leakage Testing shall be performed in accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

- .1 Fabrication: to SMACNA and ASHRAE.
- .2 Radiused elbows.
 - .1 Rectangular: standard radius, short radius with single thickness turning vanes, Centreline radius: 1.5 times width of duct.
 - .2 Round: smooth radius. Centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with minimum single thickness turning vanes.
 - .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with 45 degrees entry on branch.
 - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
 - .1 Full or short radiused elbows as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.

2.6 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping.
- .2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A 653/A 653M, G90/Z275 zinc coating.
- .2 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA.
- .3 Joints: to ASHRAE and SMACNA. Proprietary manufactured duct joints to be considered if meet class A seal.

2.8 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .2 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .1 Maximum size duct supported by strap hanger: 500.
- .3 Hanger configuration: to ASHRAE and SMACNA.
 - .1 Hangers: galvanized steel angle hangers with supporting rods, locking nuts and washers to ASHRAE and SMACNA as per the following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)	Spacing (m)
up to 750	25 x 25 x 3	6	3
751 to 1050	40 x 40 x 3	6	3
1051 to 1500	40 x 40 x 3	10	3
1501 to 2100	50 x 50 x 3	10	2.5
2101 to 2400	50 x 50 x 5	10	2.5
2401 and over	50 x 50 x 6	10	2.5
- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp, steel plate washer.
 - .3 For steel beams: manufactured beam clamps.

PART 3 EXECUTION

3.1 GENERAL

- .1 Do work in accordance with ASHRAE and SMACNA standards.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100 mm beyond insulated duct
 - .2 Ensure diffuser is fully seated
- .3 Support risers in accordance with SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths and diameter to accommodate installation of ½" internal acoustic duct lining where indicated on drawings.
- .7 Ground across flexible connector with No. 2/0 braided copper strap.
- .8 Provide offsets as required to prevent interferences.
- .9 Install Air Duct Accessories defined in Section 23 33 00.
- .10 Install 1" test plugs, with chain and cap, where required to accommodate testing and balancing instruments.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.

3.3 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

3.4 LEAKAGE TESTS

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems
- .2 Perform visual inspections throughout construction to ensure proper sealing.
- .3 Self-perform trail leakage tests as required to ensure sealing techniques are adequately achieving desired seal classification.
- .4 Provide ductwork free of audible leaks in quiet ambient.
- .5 Complete tests before performance insulation or concealment Work.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 07 84 00 - Firestopping.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .4 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa__

1.3 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions: submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Certification of Ratings:
 - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Contractor Certification: The Contractor shall certify the following:
 - .1 The products and systems were installed in strict compliance with the specifications, manufacturer's recommendations and all applicable local or state codes.
 - .2 The specified field tests have been satisfactorily performed.
 - .3 The equipment was protected from dust and debris throughout construction and cleaned in accordance with Section 21 05 01

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame 0.66mm thick with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².
- .3 Standard of Acceptance:
 - .1 Duro-dyne, Vent Fabrics

2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene sponge air seal all around.
- .4 Hardware:
 - .1 Up to 300 x 300mm: two sash locks complete with safety chain.
 - .2 301 to 450mm: four sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides
 - .5 Hold open devices.
- .5 Standard of Acceptance:
 - .1 Miami Carey, Air-O-Metal, Kruger, Maxam, Nailor Hart

2.4 TURNING VANES

- .1 Factory or shop fabricated single thickness and double thickness with or without trailing edge to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.

- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

PART 3 EXECUTION

3.1 GENERAL

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.
- .2 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting prior to beginning work of on-site installations in accordance
 - .1 Verify project requirements.
 - .2 Review installation conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

3.2 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to fans.
 - .2 Inlets and outlets of Rooftop Units and ERV's.
 - .3 As noted.
 - .2 Minimum distance between metal parts when system in operation: 50 mm for systems < 470 L/s CFM, 100mm for systems with >470 L/s
 - .3 Install in accordance with recommendations of SMACNA.
 - .4 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
 - .1 Size:
 - .1 600 x 600 mm for person size entry.
 - .2 300 x 300 mm for hand servicing entry and viewing.
 - .3 As indicated.
 - .2 Locations:
 - .1 Fire and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 Elsewhere as indicated.
- .3 Instrument Test Ports:

- .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.
 - .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Engineer.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
- .4 Turning vanes:
 - .1 Install in accordance with recommendations of SMACNA.
 - .2 Install turning vanes on all supply, return and exhaust air ductwork with widths greater than 610mm.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.
 - .2 Operating dampers for mechanical forced air ventilation and air conditioning systems.
 - .3 Fire and smoke dampers, and fire stop flaps.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 07 84 00 - Firestopping.
- .3 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa

1.3 REFERENCES

- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - .1 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN4-S112-[M1990], Fire Test of Fire Damper Assemblies.
 - .2 ULC-S505-[1974], Fusible Links for Fire Protection Service.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions: submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Certification of Ratings:
 - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Contractor Certification: The Contractor shall certify the following:
 - .1 The products and systems were installed in strict compliance with the specifications, manufacturer's recommendations and all applicable local or state codes.

- .2 The specified field tests have been satisfactorily performed.
- .3 The equipment was protected from dust and debris throughout construction and cleaned in accordance with Section 21 05 01

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Manufacture to SMACNA standards.
- .2 Acceptable Manufacturer:
 - .1 Alumavent.
 - .2 Ventex.
 - .3 Tamco.
 - .4 Nailor.

2.2 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to meet SMACNA requirements.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness where indicated.
- .4 Inside and outside nylon or bronze end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm.
- .4 Bearings: self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Operator: Refer to Division 25
- .8 Maximum leakage: 1 % at 500Pa static pressure.

2.4 MULTI-LEAF INSULATED DAMPERS

- .1 Opposed blade type.

- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Operator: Refer to Division 25
- .6 Performance:
 - .1 Leakage: in closed position less than 90 L/s/sq m of rated air flow at 250 Pa differential across damper in accordance with ASHRAE 90.1
- .7 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
 - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

2.5 BACK DRAFT DAMPERS

- .1 Automatic gravity operated, aluminum or steel construction with nylon bearings, spring assisted or counterweighted.

2.6 RELIEF DAMPERS

- .1 Automatic multi-leaf aluminum dampers with vinyl seals, with ball bearing centre pivoted and counter-weights set to open at 10 Pa static pressure.

2.7 FIRE DAMPERS

- .1 Fire dampers: arrangement Type A, B, C, listed and bear label of ULC, and meet requirements of provincial fire authority, Fire Commissioner of Canada (FCC), ANSI/NFPA 90A, and all authorities having jurisdiction. Fire damper assemblies fire tested in accordance with CAN4-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
 - .1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
 - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; roll door type; guillotine type; sized to maintain full duct cross section.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.

- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

2.8 SMOKE DAMPERS

- .1 Smoke Dampers: to be ULC or UL listed and labelled.
- .2 Normally closed reverse action smoke vent (S/D-RASV): folding blade type, opening by gravity upon detection of smoke, and/or from remote alarm signaling device actuated by an electro thermal link as indicated. Two flexible stainless steel blade edge seals to provide required constant sealing pressure.
- .3 Normally open smoke/seal (S/D-SSSD): folding blade type, closing when actuated by means of electro thermal link and/or from remote alarm signaling device. Blade edge seals of flexible stainless steel to provide required constant sealing pressure. Provide stainless steel negator springs with locking devices to ensure positive closure for units mounted horizontally in vertical ducts.
- .4 Motorized (S/D-M): folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.
- .5 Electro thermal link (S/D-ETL): dual responsive fusible link which melts when subjected to local heat of 74 degrees C and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.

2.9 FIRE STOP FLAPS

- .1 Fire smoke flaps: ULC listed and labelled and fire tested in accordance with CAN4-S112.2.
- .2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.
- .3 Flaps held open with fusible link conforming to ULC-S505 and close at 74 degrees C or as indicated.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .2 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .3 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .4 Ensure damper operators are observable and accessible.
- .5 Corrections and adjustments conducted by Engineer.
- .6 Seal multiple damper modules with silicon sealant.

3.3 INSTALLATION OF FIRE DAMPERS

- .1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Coordinate with installer of firestopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.

3.4 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation of flexible ductwork, joints and accessories.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 07 84 00 - Firestopping.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .4 Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .5 Section 23 33 00 – Air Duct Accessories

1.3 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, [95] (Addendum No.1, November 1997).
 - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition [1995].

1.4 SUBMITTALS

- .1 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate the following:
 - .1 Application of flexible ducts,
 - .2 Thermal properties.
 - .3 Friction loss.
 - .4 Acoustical loss.
 - .5 Leakage.
 - .6 Fire rating

1.5 QUALITY ASSURANCE

- .1 Certification of Ratings:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Factory fabricated to CAN/ULC-S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.
- .4 Length of flexible duct shall not exceed 2,440 mm.
- .5 Standard of Acceptance
 - .1 Thermaflex
 - .2 Wiremold Co
 - .3 Flexmaster

2.2 METALLIC - UNINSULATED

- .1 Allowable for Supply, Return and Exhaust air diffuser/grille connections not required to have acoustic connection.
- .2 Spiral wound flexible aluminum or stainless steel.
- .3 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.

2.3 METALLIC - INSULATED

- .1 Allowable for Outside Air diffuser/grille connections.
- .2 Spiral wound flexible aluminum with factory applied, 50 mm thick flexible glass fibre thermal insulation with vapour barrier and vinyl, reinforced mylar/neoprene laminate, or aluminum jacket.
- .3 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.

2.4 NON-METALLIC - UNINSULATED

- .1 Allowable for Supply, Return and Exhaust air diffuser/grille connections not required to have acoustic connection.
- .2 Non-collapsible, coated mineral base fabric, aluminum foil mylar type, mechanically bonded to, and helically supported by, external steel wire, as indicated.
- .3 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3

2.5 NON-METALLIC - INSULATED

- .1 Allowable for Outside air diffuser/grille connections.
- .2 Non-collapsible, coated mineral base fabric, aluminum foil/mylar type mechanically bonded to, and helically supported by, external [steel wire with factory applied, 37 mm thick flexible mineral fibre thermal insulation with vapour barrier and vinyl reinforced mylar/neoprene laminate jacket.
- .3 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3

2.6 NON-METALLIC - ACOUSTIC INSULATED

- .1 Shall be used for diffuser/grille connections in the following locations:
 - .1 N/A
- .2 Non-collapsible, coated mineral base perforated fabric type helically supported by and mechanically bonded to steel wire with factory applied flexible mineral fibre acoustic insulation and encased in aluminum foil/mylar laminate Type M vapour barrier.
- .3 Performance:
 - .1 Factory tested to 2.5kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.
 - .3 Acoustical performance: Minimum attenuation (dB/m) to following table:

	Frequency (Hz)				
Duct	125	250	500	1000	2000
Diam:					
[100]	[0.6]	[3]	[12]	[27]	[0]
[150]	[1.2]	[3]	[12]	[22]	[27]
[200]	[2.0]	[5]	[12]	[19]	[20]
[300]	[2.4]	[5]	[12]	[16]	[15]

PART 3 EXECUTION

3.1 DUCT INSTALLATION

- .1 Install in accordance with: CAN/ULC-S110, UL-181 and SMACNA Requirements.
- END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Fans, motors, accessories, and hardware for commercial use.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 78 00 - Closeout Submittals
- .3 Section 21 05 01 – Common Work Results for Mechanical.
- .4 Section 21 07 16 - Thermal Insulation for Equipment

1.3 REFERENCES

- .1 Air Conditioning and Mechanical Contractors (AMCA)
 - .1 AMCA Publication 99, Standards Handbook.
 - .2 AMCA 300, Reverberant Room Method for Sound Testing of Fans.
 - .3 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.181-[99], Ready-Mixed Organic Zinc-Rich Coating.

1.4 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, total and static pressure, bhp, W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
 - .4 Sound ratings: comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal.
 - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

1.5 SUBMITTALS

- .1 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate the following:
 - .1 General arrangement, drawing of each unit including product description, model

- number, dimensions, unit weights, mounting,
 - .2 Fan make, model and performance information including: fan curves with specified operating point clearly indicated,
 - .3 Motor, sheaves, bearings, shaft details
 - .4 Fan efficiencies, fan isolation details.
 - .5 Minimum performance achievable with variable speed controllers where applicable
 - .6 Clearances for operation, maintenance, servicing.
 - .7 Sound power levels for each octave band for at fan inlet, fan outlet and each unit opening.
 - .8 Submit product data of filter media, filter performance data, filter assembly, and filter frames.
 - .9 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed disconnects and field-installed wiring.
 - .10 Details of sensors or prewired controls devices
- .3 Omission of any of the above information will cause shop drawings to be immediately returned without review.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials and all factory tests comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .3 Operation and Maintenance Manuals: manufacturer's printed operation and maintenance manuals shall be submitted.
 - .4 Manufacturer's Warranties: Manufacturer's printed warranties, as specified hereinafter, shall be submitted.
- .3 Closeout Submittals:
 - .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 QUALITY ASSURANCE

- .1 Manufacturer's Certification: The manufacturer shall certify the following:
 - .1 The products and systems furnished are in strict compliance with the specifications.
 - .2 The equipment components have been properly coordinated and integrated to provide a complete and operable unit.
 - .3 Fans conform to AMCA bulletins regarding testing and construction. (Airfoil fans shall bear the AMCA certified rating seal for airflow and sound).
 - .4 Filter media is ULC listed.
 - .5 The specified factory tests have been performed and passed
 - .6 After construction, units were cleaned thoroughly before shipping.
 - .7 Prior to shipping units where stored in a dry heated environment, fan wheels were rotated monthly and inspected regularly for damage.
- .2 Contractor Certification: The Contractor shall certify the following:
 - .1 The products and systems were installed in strict compliance with the specifications, manufacturer's recommendations and all applicable local or state codes.
 - .2 The specified field tests have been satisfactorily performed.
 - .3 Units received on site were as specified
 - .4 Units received were free from damage
 - .5 From the time of receipt of the units on site to turn over to the owner, the units were maintained in a weather tight fashion and inspected regularly. Fan wheels were rotated

monthly and any job site moisture was removed immediately.

1.7 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Spare parts to include:
 - .1 Matched sets of belts.
 - .3 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .4 Addresses of suppliers.
 - .5 List of specialized tools necessary for adjusting, repairing or replacing.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

PART 2 PRODUCTS

2.1 FANS GENERAL

- .1 Motors:
 - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
 - .2 For use with variable speed controllers where indicated.
 - .3 Sizes as indicated and specified on drawings
- .2 Accessories and hardware: matched sets of V-belt drives, variable motor sheaves, adjustable slide rail motor bases, belt guards, coupling guards fan inlet and outlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment
- .3 Factory primed painted and enamel finish in colour standard to manufacturer.
- .4 Scroll casing drains: as indicated.
- .5 Heavy duty self-aligning bearings with lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .6 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .7 Flexible connections: to Section 23 33 00 - Air Duct Accessories

2.2 ROOF MOUNTED EXHAUST FAN

- .1 Centrifugal V belt or direct driven as indicated.
- .2 Housings: spun aluminum complete with resilient mounted motor and fan on neoprene anti-vibration pads.
- .3 Impeller: aluminum non-overloading.

- .4 Adjustable motor sheave
- .5 Accessories:
 - .1 12mm mesh aluminum birdscreen.
 - .2 Automatic motorized gasketed aluminum backdraft dampers.
 - .3 Disconnect switch within fan housing.
 - .4 Continuous curb gaskets, stainless steel securing bolts and screws, and curbs where indicated.
 - .5 Hinge curb plate for access to internals for maintenance.
- .6 Standard of Acceptance:
 - .1 Cook, Greenheck, Pennbarry, Jenco

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 FAN INSTALLATION

- .1 Install fans as indicated, with flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL SUMMARY

- .1 The Controls System Contractor shall supply and install a complete Direct Digital Control (DDC) System as required to accomplish the specified Sequences of Operation for control of heating, ventilating, air-conditioning, and other building equipment, and systems as described in this specification.
- .2 System Requirements
 - .1 BACnet®. The control system shall consist of a high-speed, peer-to-peer internetwork of ANSI/ASHRAE Standard 135 native BACnet devices. The control system shall also incorporate input/output devices, mechanical/electrical automatic temperature control devices, enclosures, interconnecting conduit, and cabling.
 - .2 Performance Monitoring. The System shall provide the specified performance monitoring functionality, including required monitoring points and performance metrics, system accuracy, data acquisition and data management capabilities, as well as all required graphical and data displays.
 - .3 Browser-Based User Interface. The System shall support a Browser-based User Interface (BUI) to the System data. An Operator using a standard web browser shall be able to access the control system graphics and change adjustable setpoints.
- .3 System Architecture
 - .1 BACnet internetwork. The System as provided and installed under this specification shall comprise a BACnet internetwork with a multitiered architecture.
 - .2 All communication shall conform to ANSI/ASHRAE Standard 135: BACnet.
 - .3 Tier 2 Building Level Communication Network (BLCN). This network architecture tier comprises the primary building-level infrastructure for the connection of building- and facility-level systems, and FLCNs.
 - .4 Tier 2 BLCNs shall be BACnet networks comprised of:
 - .1 Building-level BACnet controllers,
 - .2 Building-level data archival and analytics,
 - .3 Local workstations and operator interfaces,
 - .4 System-level integration,
 - .5 Routers for the interconnection of FLCNs, and
 - .6 Building-level BUI.
 - .5 Tier 2 BLCNs shall use one the following BACnet data links only:
 - .1 BACnet/IP: ANSI/ASHRAE Standard 135 Annex J.
 - .2 B/VPN: BACnet Virtual Private Network.
- .4 Drawings are diagrammatic only. Control equipment and labor not specifically referred to here or on the plans, which are required to meet the functional intent, interconnect controllers and associated systems to be controlled shall be provided without additional cost to the Owner.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control
- .3 Section 01 61 00 - Common Product Requirements

- .4 Section 01 78 00 - Closeout Submittals
- .5 Section 01 91 13 - General Commissioning (CX)
- .6 Section 26 60 10 – Powered Equipment Schedule
- .7 Section 27 05 28 – Pathways – Communication Systems

1.3 REFERENCES

- .1 All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, provincial, and federal authorities. Such codes, when more restrictive, shall take precedence over these drawings and specifications.
- .2 At a minimum, the installation shall comply with the current editions in effect thirty (30) days prior to receipt of bids of the following applicable codes:
 - .1 ANSI/ASHRAE Standard 135: BACnet - A Data Communication Protocol for Building Automation and Control Networks.
 - .2 Canadian Electrical Code, Part 1 (CSA C22.1-12).
 - .3 Ontario Building Code (OBC).
 - .4 Underwriters Laboratories (UL).
 - .1 UL-916 – Energy Management Systems (EMS).
 - .2 UL-864/UUKL – Control Units and Accessories for Fire Alarm Systems.

1.4 SUBMITTALS

- .1 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submittals for all equipment, hardware and system network shall be submitted within 8 weeks from project award. Following approval of Controls equipment package, major Mechanical and Electrical equipment shop drawings the Consultant will prepare and issue a guidance sequence of operation that the BAS contractor can use in preparation of the final BAS Submission which is to be inclusive of all schematics, graphics and sequences.
- .3 System Hardware Submittals. Submit the following at a minimum:
 - .1 A complete Bill of Materials of all equipment, controllers, devices, and sensors to be provided and/or used indicating unique equipment identifier, unique device identifier, manufacturer, model number, and quantity.
 - .2 A Protocol Implementation Conformance Statement (PICS) including a BACnet Interoperability Building Block (BIBB) table for each DDC device included in the submittal.
 - .3 Manufacturer's technical data including product specification sheets, performance curves, and installation/maintenance instructions. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly called out by other means.
 - .4 Schematic diagrams for all field sensors and controllers providing floor plans indicating the locations of all sensors, devices, and temperature control panels.
 - .5 Control enclosure details for each enclosure including panel identifier, location, physical lay-out, dimensions, instrumentation, labels, etc.
 - .6 Wiring diagrams and schematics for each control enclosure showing power source for each panel, secondary power, and network termination as well as all individual terminations, terminal numbers, point type, and mnemonic/name.

- .7 Wiring diagrams for all packaged equipment, motor starters, relay wiring, equipment interlock, safety circuits, etc. clearly indicating all interconnecting wiring and termination of all conductors and cables including labels of all cables and point mnemonics.
- .8 Wiring diagrams and schematics for each sensor.
- .4 Controlled System Submittals.
 - .1 Riser diagram showing the physical lay-out of the entire internetwork. The design shall take into account mechanical and electrical equipment locations and requirements.
 - .2 Riser diagram for each individual BACnet network including the ELCN, and each BLCN and FLCN including:
 - .1 Data link with physical characteristics and configuration.
 - .2 Each BACnet networked DDC device including location, service, device instance, MAC address, and network number.
 - .3 Each IP networking device including location, service, and IP address.
 - .4 Location of all interface devices including network interface jacks and workstation connections.
 - .5 Location of all MS/TP network termination points and End-of-Line (EOL) terminations.
 - .3 A schematic control flow diagram of each controlled system showing actual physical configuration and location of all control elements including each hardware point type, controller, and mnemonic.
 - .4 A schematic wiring diagram of each controlled system showing actual physical wiring and termination of all control elements including each hardware point type, controller, mnemonic, and terminal number.
 - .5 An instrumentation list for each controlled system displaying each control element, name, manufacturer, model, and product data sheet number in a tabular format.
 - .6 A complete description of the operation of the System including a specific Sequence of Operation for each controlled system. Sequences of Operation shall:
 - .1 Reference the submitted schematic of the controlled system.
 - .2 Refer to equipment and control devices by their specific unique identifiers pursuant with the Contract Documents and the System submittal package.
 - .3 Clearly represent actual application programming methodology and functional control operation not merely a copy of the Contract Document specified sequence of control.
 - .4 Include a concise description of functional system operation under specified normal and failure conditions.
 - .5 Include a complete hardware input and output (I/O) points schedule identifying for each point its instance, type, name/mnemonic, controller, equipment/function, location, termination, override, alarm, and display criteria.
 - .7 Operational deviation from the specified Sequences of Operation as outlined in Contract Documents shall not be permitted under any circumstances without prior written approval by the Owner, Engineer, or Contracting Officer.
 - .8 A schedule of all control valves. This shall include the unique equipment identifier, valve size, dimensions and installation/maintenance clearance, model number (including pattern and connections), close-off rating, flow, CV, pressure drop, pressure rating, and location. The valve schedule shall also contain actuator selection data supported by calculations of the force required to move, close, and seal the valve at design conditions.

- .9 A schedule of all control dampers. This shall include the unique equipment identifier, unique damper identifier, damper size, pressure drop, blade configuration, orientation and axis of frame, blade rotation, location and selection criteria of actuators, nominal and actual sizes, manufacturer, and model number. The Damper Schedule shall include the AMCA 500-D maximum leakage rate at the operating static-pressure differential.
 - .10 Graphics; For each screen, provide a conceptual layout of pictures and data and show or explain which other screens can be directly accessed.
 - .11 It will absolutely not be necessary for the owner to sign any type of confidentiality agreement or contract or agreement to obtain control over the BAS System or BAS software. The software will become the property of the owner at time of building turnover.
 - .12 Quantities of items submitted shall be reviewed, but are the responsibility of the contractor.
- .2 Schedules.
- .1 Within one month of Contract award provide a schedule of work indicating at a minimum the intended sequence of work, start dates and durations for individual activities, delivery dates for major materials and equipment including anticipated lead times, and milestones indicating possible restraints on work by other trades or construction delays.
- .3 Training.
- .1 Provide training course outline and curricula at least six (6) weeks prior to training. Engineer and/or Owner shall modify the curricula as necessary to meet the Owner's Project Requirements (OPR). Revised curricula shall be returned no later than three (3) weeks prior to the training.
- .4 Closeout Submittals:
- .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Upon completion of installation and System commissioning activities submit record (as-built) documents for review to include:
 - .1 Testing and commissioning reports and checklists.
 - .2 Operation and Maintenance (O&M) manuals.
 - .3 As-built revisions of all submittal data updated to reflect actual field conditions, architecture and execution.
 - .4 Names and 24-hour contact information for installing contractors and service representatives.
 - .5 Operator's manual with administrator and operator level credentials and procedures for operating the System including logging-on/off, handling alarms, generating points reports, trending data, overriding automatic control, changing setpoints, and control variables.
 - .6 One set of programming manuals with a description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the editor.
 - .7 Engineering, installation, and maintenance manual(s) that explain how to design and install new points, panels, and other hardware' preventive maintenance and calibration procedures' how to debug hardware problems' and how to repair or replace hardware.
 - .8 Installation and maintenance manuals describing how to install and configure new hardware as well as how to perform routine preventative maintenance and calibration together with corrective diagnostic troubleshooting procedures.

- .9 Documentation of all programs created including setpoints, tuning parameters, and final database.
- .10 Complete system database as functional after system commissioning and functional testing including all graphics and images used by and/or created for System on electronic format as accepted by the Owner.
- .11 Final Bill of Material with all installed parts, manufacturers' part numbers, and ordering information.
- .12 A schedule of recommended spare parts with part numbers and supplier.
- .13 All original-issue installation and maintenance manuals, user guides, and other documentation provided with all hardware and software provided as a part of this specification.
- .14 Licenses, guarantees, and warrantee documentation for all equipment and systems.
- .15 Recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration), time between tasks, and task descriptions.

1.5 QUALITY ASSURANCE

- .1 The DDC System Manufacturer shall be engaged full-time and shall have been engaged full-time for a minimum of ten (10) years, in the manufacture of equipment and devices of the scope, size, and service consistent with the requirements for this project.
- .2 The System Contractor shall specialize, and have a minimum of five (5) years of experience in, the design, installation, programming, and operation of Systems consistent with the scope, size, and service specified; and shall:
 - .1 Be an officially authorized representative of the System Manufacturer with an established relationship of not less than three (3) years.
 - .2 Assign to the project technicians and engineers who are officially trained and certified by the System Manufacturer in the design, installation, programming, and operation of the System components.
 - .3 Upon request, the System Contractor shall present certifications of completed training including hours of instruction and course outlines for all technicians and engineers assigned to, and/or otherwise employed on, the project.
- .3 The system manufacturer shall maintain a monitoring center manned 24 hours a day, 7 days a week, 365 days a year by company personnel capable of continuous monitoring of environmental conditions in various areas throughout the building.
- .4 DDC System Manufacturer shall have in-place support personnel located within 3.5 hours of the site with technical staff, spare parts inventory, and all necessary test and diagnostic equipment.
- .5 Div 25. Contractor shall provide 100 percent of all services with company personnel. No portion of services can be subcontracted to others without express written permission of the consultant, and with such permission, all specifications, terms, and conditions specified herein shall be the responsibility of the prime Contractor.
- .6 The BACnet internetwork shall be based upon, and installed according to, the System Manufacturer's standard integrated hardware and software product design and in accordance with the System Manufacturer's installation and application documentation.

1.6 WARRANTY

- .1 Provide a comprehensive Labor and Materials warranty for the Direct Digital Control (DDC) System for a period of one (1) year from the date of substantial completion. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner.
- .2 The contractor shall respond to the Owner's request for warranty service within 24 hours.
- .3 This warranty shall cover defects in materials and workmanship for the controls system inclusive of all 3rd party products that form part of the system.
- .4 Provide an extended 5 warranty for all DDC controllers; The system manufacturer shall warranty all DDC controllers to be free from defect in material and workmanship under normal operation and expected service.
- .5 Submit warranty information in accordance with Section 01 78 00 – Closeout Submittals.
- .6 Operator workstation software, project-specific software, graphic software, database software, and firmware updates that resolve known software deficiencies as identified by the contractor shall be provided at no charge during the warranty period. All corrective software modifications made during the warranty period shall be updated on all user documentation and on user and manufacturer archived software disks.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

1.8 OWNERSHIP OF PROPRIETARY MATERIAL

- .1 Upon project acceptance all software and documentation delivered as a part of this specification shall become the exclusive property of the Owner; including but not limited to:
 - .1 Project graphic images
 - .2 Terminals
 - .3 BAS Software and Components
 - .4 Record drawings
 - .5 Project database
 - .6 Project-specific application programming code
 - .7 All documentation

PART 2 PRODUCTS

2.1 MANUFACTURERS

- .1 List of approved Div 25 Contractors and DDC Manufacturers:
 - .1 **Reliable Controls – Mach (Base Designed Product)**
 - .2 Honeywell – ComfortPoint
 - .3 Johnson Controls – Facility Explorer (FX)
 - .4 Siemens – Desigo/Apogee BACnet
 - .5 Distech Controls

- .2 This approval is based on product quality and similarity, however, confirmation that the final products selected meet the requirements of this specification is the responsibility of the Contractor.
- .3 Although it is preferred that associated DDC products specified herein (e.g., sensors, valve dampers, and actuators) originate from same manufacturer, this is not a requirement. Products will need to be selected to meet the requirements and performance standards noted within this specification.
- .4 It is the responsibility of the BAS contractors noted above to review the tender documents to ensure they can provide the entire system, programming, integration, commissioning, labour and material in accordance with the drawings and related specification sections.

2.2 GENERAL PRODUCT REQUIREMENTS

- .1 The System as provided and installed under this specification shall be comprised of BACnet devices including controllers, routers, operator workstations, operator displays, and supervisory software from a single manufacturer and product line or product family.
- .2 The System Manufacturer product line selected shall be the most current and complete offering and shall currently be actively manufactured and supported and shall have been installed in a minimum of 25 installations at the time the bid date for this project.
- .3 This project shall not be used as a test site. First release and test version hardware, software, and firmware shall not be implemented on this project under any circumstances.
- .4 The entirety of the System Manufacturer product line selected shall be designed and deployed specifically with standard provisions for integral backwards compatibility and extensibility.
- .5 System Manufacturer shall certify that System devices, and spare or equivalent components shall be readily available for a minimum of five (5) years after the completion and final acceptance of this project.
- .6 System Manufacturer shall certify that its own DDC product line in its entirety, and as was in mainstream service ten (10) years prior to the bid date for this project, are still supported. Support shall include complete viability and compatibility of the legacy components with the current mainstream product line; and availability of replacement or equivalent compatible components and/or repair services.
- .7 OEM and/or private-labelled controllers or software manufactured or developed by a third-party and labelled or otherwise represented as being a product of the System Manufacturer shall not be accepted under this specification.
- .8 Non-networked system components specified in this section (including sensors, valves, dampers, etc.) need not be manufactured by the System Manufacturer.
- .9 Supply and installation of material as required for a complete Direct Digital Control (DDC) System as required to accomplish the specified Sequences of Operation, which generally includes:
 - .1 All Building Automation System Controllers inclusive of software, power supplies and associated wiring
 - .2 Equipment Cabinets
 - .3 Control Valves
 - .4 Control Damper Actuators
 - .5 All sensors, thermostats, meters and end devices unless specifically noted by another

- Division.
- .6 All Low Voltage wiring required for control of equipment (ie: low water cutoffs, high limits, safeties etc...)
- .7 Thermowells for sensors
- .8 Control Pushbuttons and Timers where indicated.
- .9 Control Pilot Lights
- .10 Control Power for equipment by other divisions, but connected to the equipment of this division (ie: magnahelic gauges, air flow stations etc...)
- .11 Relays where required to integrate with voltages different than supported by BAS equipment.
- .12 BAS Surge Suppression Modules
- .13 Relays where required to integrate with voltages different than supported by BAS equipment.
- .14 IP Building Controls Network including rack mounted server, switches, ups and all IP cabling to connect to BAS controllers and 3rd party IP controllers
- .15 Network Adapters (MODBUS RTU/MSTP, BACnet IP, etc...) as required for integration to other components of the system.
- .10 Execution
 - .1 Engineering for systems configuration, shop drawings, and installation drawings.
 - .2 Complete programming for a fully operational system including specified integrations, system graphics, device programming and setup.
 - .3 System commissioning as described in within this specification and Div 1 for a completely functional system including all specified integration, training, as-built documentation, and 1 year parts and labour warranty.
 - .4 Electrical installation as follows;
 - .1 Div 25 to identify all line voltage power requirements as part of the system design and installation drawings. Coordinate all requirements with Div 26 to provide and utilize "controls" or "spare" breakers provisioned within local panels.
 - .2 Div 26 shall provide the installation of all line (120V) voltage connections to power BAS controllers, cabinets, actuators etc to suit final approved shop drawings.
- .11 Additional Devices
 - .1 During shop drawing approval and finalization of the sequence of operations specific to the approved system it may become necessary to add a few controls devices and points. Include for incorporation of up to 5 additional controls devices/sensors (ie. Room thermostats, relays, pressure sensors, duct sensors etc) as may be required in addition to those shown in the drawings.
 - .2 Include for installation and low voltage wiring as required to install these additional controls devices/sensors.
- .12 The BAS building management and control functions to be provided include:
 - .1 Building management and control
 - .2 Monitoring and control of BAS controllers, remote devices, and 3rd party controllers provided with HVAC equipment
 - .3 Operator interface to allow general supervision of room controls and access to Div. 26 lighting control system.
 - .4 Integration of Div. 26 electrical distribution power monitoring; refer to Electrical Drawings for scope of programming/integration of power monitoring and facility trending.
 - .5 Data collection and historization
 - .6 Alarm management
 - .7 Trending

- .8 Report generation
- .9 Building IP Network integration.
- .13 At a minimum, the following data shall be accessible:
 - .1 Space temperature and humidity where applicable
 - .2 Space temperature set point
 - .3 Occupancy status
 - .4 Operating mode
 - .5 Speed (% or hz)
 - .6 Valve positions
 - .7 Air volume flow
 - .8 Percent terminal load
 - .9 Time schedules
 - .10 Zero energy bands
 - .11 Room name
 - .12 Terminal type, e.g., fan coil
 - .13 Div. 26 Lighting Control System (Lighting Control Interface Access from HMI and Occupancy status integration).
 - .14 Div. 28 Fire Alarm System Status ("Alarm" and "Supervisory" status).

2.3 SYSTEM PERFORMANCE

- .1 Performance Standards. The System shall conform to the following minimum performance standards using the project-deployed, normal-service, production hardware, firmware, software, and network connections:
 - .1 Graphic Display. A minimum of 50 dynamic real-time data points shall be displayed within 10 seconds of the request and shall refresh with current data within 5 seconds.
 - .2 Operator Command. The maximum time between the command of a binary or analog object by the operator and the reaction initialization by the device shall be 2 seconds.
 - .3 Object Command. Devices shall respond to automatic command of a binary or analog object within 2 seconds.
 - .4 Object scan. Changes of state or analog values shall be transmitted such that reporting of a value is never more than 15 seconds old and is reported within 15 seconds of a change in value.
 - .5 Alarm Response. The maximum amount of time from when an object goes into alarm until it is annunciated at the workstation shall not exceed 20 seconds.
 - .1 Each workstation on the network shall receive alarms within 5 seconds of other workstations.
 - .6 Program Execution. All programs in all DDC devices shall be able to execute at a minimum of at least one time every second. Program execution time shall be configurable to be consistent with the process under control.
 - .7 Control Loop Performance. All DDC devices shall be able to execute control loops at a frequency at least one time every second. The controller shall update the process value and output generated by this calculation at this same frequency at a minimum or as appropriate for the mechanical process under control.
- .2 Environmental Conditions. All System components provided under this specification shall operate under ambient environmental conditions of -20°C (-4°F) to 55°C (131°F) dry-bulb and 10% to 90% relative humidity, non-condensing at a minimum. Sensors and control elements shall be constructed of materials suitable and rated for the media sensed under the ambient environmental temperature, pressure, humidity, and vibration conditions typical for the installed location.

- .3 Power Conditions. Networked components of the System shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.
- .4 Reporting Accuracy. System shall report values with minimum end-to-end accuracy as listed in Table 1 through Table 5.
- .5 Control Stability and Accuracy. Control applications shall maintain process variables at setpoint within the tolerances listed in Table 1 through Table 5 inserted at the end of this specification section.
 - .1 Combined system repeatability of sensors, controllers, and readout devices for a particular application shall be $\pm 2\%$ of full scale of the operating range.
 - .2 Repeatability of overall combined system of sensor, controller, and readout device in a control loop application will be $\pm 5\%$ of full scale of the operating range.
 - .3 Long-term electronic drift shall not exceed 0.4% per year.

2.4 BAS NETWORK EQUIPMENT (SERVER, SWITCHES, UPS)

- .1 Provide all hardware required to support the BAS Network and host the BAS Enterprise Software inclusive of a rack mounted server, network switches and UPS.
- .2 System rack mount server computer shall comprise the following minimum hardware:
 - Intel Xeon E-2126G 3.3GHz, 12 MB Cache - minimum
 - 32 GB 2666MT/s DDR4 UDIMM RAM - minimum
 - Hard Disk storage to meet storage requirements for all network related programs and trending - Minimum 2 x 1TB SSD in RAID1 configuration
 - 2 @ 1Gbps NIC
 - Windows Server 2019
 - Cabled power supply c/w NEMA 5-15P plug
- .3 Server System software:
 - Operating system. Furnish a concurrent multitasking operating system to suit project requirements. Operating system shall also support common software applications, such as Microsoft Excel, Microsoft Word, and Access. Acceptable operating systems are Windows Server version to suit the system operational requirements. The networking software shall use industry standard TCP/IP LAN protocol. System peripherals shall be capable of being connected to the server computer via the LAN. The operator interface shall also be compatible with Windows Terminal Services, allowing remote PDA devices to be used as mobile operator interfaces.
 - System graphics: Operator interface shall be graphically oriented and allow for efficient communication of operational data and abnormal conditions. Graphics shall support at least 65,000 colors at a minimum 1024 x 768 pixel resolution. It shall provide a consistent framework for viewing of information. Critical areas (such as alarm icons) shall be visible at all times. A predefined area on the screen shall provide operator messaging, and this area shall be visible at all times. A set of standard displays for configuration and navigation around the FMS system shall be provided with every system and not require any engineering. FMS shall also have an unlimited number of custom (facility-specific) displays created to meet the needs of the specific facility.
 - Operator interface shall employ standard Windowing conventions to reduce required operator training. Standard tool bar icons and drop-down menus shall be available on standard and custom displays to allow access to common functions. Tool bar and pull-down menus shall be fully configurable. Similarly, such functions shall also be available via a standard set of function-key-based pushbuttons without requiring

configuration. The interface shall support a mouse and touch screen for pointing and command input.

- Operator interface shall support the ability to full screen lock the window so users cannot access other applications. If full screen lock is not enabled, support for copy-and-paste facilities shall be provided between the operator window and other Microsoft applications.

.4 Controls Network Switches

- Supply and install two (2) rack mounted 24-port Cisco Layer 2 managed network switches capable of having Cisco Smartnet service contract (exact model to be confirmed with Consultant/Owner IT at time of shop drawing review). Coordinate installation of new switches in proposed new IT Room and work directly with Owner IT dept for associated programming of network switches to suit Owner standard to enable future maintenance and access of the building network by the Owner IT dept.

.5 Rack mounted UPS

- Provide a rack mounted UPS to be located in the Div. 27 rack in IT Room
- UPS to be sized with additional 50% capacity to suit BAS server and associated network switch BAS Equipment.

2.5 COMMUNICATIONS

.1 The System as provided and installed under this specification shall comprise a BACnet internetwork.

- .1 All communication between System devices, including operator workstation and operator display communication, provided and/or installed under this specification shall conform to ANSI/ASHRAE Standard 135, BACnet using native BACnet communications.
- .2 All devices shall utilize a native BACstack embedded at the media access controller level.
- .3 Devices that require translation of data, gateways, or mapping of any kind for communication between System devices shall not be acceptable.

.2 BTL. All System devices provided and installed under this specification shall be tested, certified, clearly stamped, and listed by the BACnet Testing Laboratories (BTL) a minimum of 30 days prior to the bid date for this project.

- .1 BTL product listings are available from BACnet International (<http://www.bacnetinternational.net/btl/>).

.3 Extensibility. The System shall be modular in nature and implemented in such a manner that it can be expanded in functionality and in capacity to at least twice the required hardware through the addition of controllers, devices, and wiring. Expansion shall not require operator interface hardware additions, software revisions, firmware revisions, or additional licensing.

.4 IP Building Controls Network

- .1 Provide CAT 6 cabling from all BAS controllers, 3rd party IP controllers (ie. HVAC equipment), Div. 26 power monitoring system, BAS Server etc.. back to and punched down at network rack in IT Room and patched to associated Section 25 supplied/installed network switch.
- .2 Provide CAT 6 drops from network switch to proposed operator workstation locations (to be confirmed), to ensure building controls network is isolated from Owner IT network.
- .3 All CAT 6 cabling is to be provided and installed in accordance with Div. 27 installation standards using cable tray and in conduit where required for protection.

2.6 SOFTWARE

- .1 Security. All operator workstation and reporting software shall support multilayered system security permissions that are defined for each individual operator to restrict/permit day-to-day operations and system configuration.
- .2 Multitasking Environment. All System software provided under this specification must be designed to operate as a Microsoft Windows process or service in a multitasking environment concurrent with other common software applications.
- .3 Graphical User Interface (GUI). The System shall provide a graphically-oriented user interface.
 - .1 The GUI shall have the ability to display the status of any object using dynamic values and animations.
 - .2 The GUI shall support at a minimum BMP, GIF, TIF, JPG, EMF, PNG, and DIB graphic file formats and allow for the use of custom animation objects and URL hyperlinks in each display.
- .4 Browser-based User Interface (BUI). The System shall support delivery of the GUI via a browser-based user interface.
 - .1 The System shall use the same GUI and deliver a consistent operator experience between operator workstation software and BUIs delivered under this specification.
 - .2 The current versions of the following standard web browsers at a minimum shall be supported by all BUIs provided:
 - .1 Google Chrome.
 - .2 Microsoft Edge 83+.
 - .3 Custom HTML programming shall not be required to create or display system graphics or data on a web page.
 - .4 BUIs must support unlimited access for a minimum of five (5) simultaneous users.
- .5 Alarm Processing. All operator workstation software shall display and log BACnet alarms and events from any object in the BACnet internetwork.
 - .1 Alarm and Event Log. All operator workstation software shall have the ability to display all alarms from any location in the internetwork.
 - .2 Alarm and Event Log shall be configurable per workstation and shall display at a minimum: alarm time, received time, state, notification class, priority, message, source, time acknowledged, acknowledged by user, and action.
- .6 Schedules. All operator workstation software shall support viewing and modification of standard binary, analog, and multistate BACnet Schedule objects and parameters.
 - .1 All operator workstation software shall display the configuration of the weekly schedule for each schedule object graphically and in a tabular format. Each calendar day shall support up to a minimum of ten (10) transitions and each transition shall be modifiable via the workstation graphically or via manual entry.
 - .2 It shall be possible to specify time schedules for the control of all BAS points. A large number of individual points shall be controlled by a single time schedule.
 - .3 All operator workstation software shall display a calendar allowing for indication and modification of Exception Schedules for any day of the year.
 - .1 Each Exception Schedule and special event shall be individually configurable including name, priority, transition values, and times.
 - .2 The Operator shall have the ability to configure Exception Schedules to be active on specific dates, date ranges, recurring date patterns, or as commanded by BACnet Calendar objects or other override objects.
 - .3 The Operator shall be able to define an exception schedule a minimum of 10

- years in advance.
 - .4 Once an exception schedule has been executed, it will be deleted.
- .7 Trend Logs. All operator workstation software shall support viewing a custom trend log including any object in the system.
 - .1 All operator workstation software shall support both the standard BACnet Trend Log and the BACnet Trend Log Multiple objects for defining custom trend logs for any object in the system.
- .8 Runtime. All operator workstation software shall support viewing logs used for reporting runtime of every binary object in the system.
- .9 The following standard system displays shall be included as part of the system. In the case of the trend and group displays, configuration of these displays shall only require entry of a point name to completely configure the display. The alarm summary, event summary, point detail, communications status, and system status shall not require any configuration. Systems where standard graphical displays, showing all parameters for each system point do not exist will not be accepted.
 - .1 Alarm summary display
 - .2 Event summary display
 - .3 Point detail template displays (for each point in the database)
 - .4 Trend set template displays
 - .5 Group control and group trend template displays
 - .6 Communications status displays
 - .7 System status displays
 - .8 Operator scratch-pad display
 - .9 Face plates for all common point types
 - .10 Configuration displays
- .10 Provide system status displays that display the following information:
 - .1 Points in alarm condition pending acknowledge command
 - .2 Points that remain in an alarm state, but which have been acknowledged
 - .3 Communication failures
 - .4 Operator workstations status
 - .5 Communication links status
 - .6 Controller status
- .11 Provide system with the following full screen administrative displays:
 - .1 Master system menu
 - .2 Report summary
 - .3 Alarm summary
 - .4 Event summary
 - .5 Display summary
 - .6 System parameters configuration
 - .7 Operator workstation configuration
 - .8 Area assignment
 - .9 Time schedule assignment
 - .10 Holiday assignment
 - .11 History assignment
 - .12 Push-button assignment
 - .13 Operator definition
 - .14 Operator message board
 - .15 Events archive and retrieval

- .16 Time period summary and configuration
- .17 Point detail for every configured point
- .12 Software applications shall reside and operate in the system controllers. Editing of applications shall occur at the operator workstation.
- .13 In the event of a power failure or disconnection from the Operations Terminal, the controllers shall continue to be fully operational with full time program capability.
- .14 Sequencing: Provide application software based upon the sequences of operation specified to properly sequence pumps, exhaust fans etc... Refer to controls drawings.
- .15 Staggered start: This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment or groups of equipment is started, along with the time delay between starts, shall be user-selectable.
- .16 Anti-short cycling: Digital output objects shall be protected from short cycling. This feature shall allow minimum on time and off time to be selected.
- .17 On and off control with differential: Provide an algorithm that allows a digital output to be cycled based on a controlled variable and set point. Algorithm shall be direct acting or reverse acting and incorporate an adjustable differential.
- .18 Duty cycle: Provide software to switch HVAC systems on and off at variable intervals to save energy while maintaining room conditions. Program shall have adjustable internal parameters for room comfort range, maximum off times, minimum off times, and motor cycle times.
- .19 Optimum start and stop: Provide a software program that calculates optimized values for starting and stopping the heating plant. Optimized start-stop function shall consider the residual heat in a building to avoid unnecessary heating operation. Required room conditions are met at all times. Optimum start and stop program calculates required flow temperature with an integrated heating curve. Two techniques shall be available: optimization without room sensor or optimization with room sensor. Optimization without room sensor uses outdoor air temperature to determine optimum start (the preheat point). Optimization with room sensor uses room control and needs a time constant (time program) and dead time to calculate the preheat point.
- .20 Zero energy band: Provide a software program that determines set points to maintain a predetermined comfort band divided into heating, cooling, and zero energy bands. ZEB subdivides a predetermined comfort band into: Heating band zero energy band cooling band. Zero energy band represents a temperature range in which the room temperature may vary without a need for heating or cooling.
- .21 Run-time totalization: Provide software to totalize run times for all digital input objects. A high run-time alarm shall be assigned, if required, by the operator.

2.7 ENTERPRISE BACNET OPERATOR WORKSTATION SOFTWARE (B-OWS)

- .1 The enterprise BACnet operator workstation (B-OWS) provides day-to-day monitoring and operation of BACnet internetworks. The enterprise B-OWS is not intended for comprehensive configuration of the System.
- .2 BACnet Device Profile. The enterprise B-OWS provided shall be certified and Listed by the BACnet Testing Laboratories (BTL) in compliance with the minimum requirements of

ANSI/ASHRAE Standard 135-2010 Revision 12 Annex L a minimum of 30 days prior to the bid date for this project as follows: BACnet Operator Workstation (B-OWS).

- .3 BACnet Networking. The enterprise B-OWS shall natively support the following BACnet data links as specified in ANSI/ASHRAE Standard 135 and in compliance with the following physical layer standards at a minimum: BACnet/IP: ANSI/ASHRAE Standard 135 Annex J.

2.8 BACNET DATA ARCHIEVE SOFTWARE

- .1 The BACnet data archive software shall automatically acquire and archive log data from standard BACnet Trend Log objects into a standard SQL database for long-term secure storage and multiyear analysis.
 - .1 The BACnet data archive software shall be a BACnet device dedicated to this service.
- .2 BACnet Device Profile. The BACnet data archive software shall be certified and Listed by the BACnet Testing Laboratories (BTL) in compliance with the minimum requirements of ANSI/ASHRAE Standard 135-2010 Revision 12 Annex L a minimum of 30 days prior to the bid date for this project as follows:
 - .1 BACnet General (B-GEN).
 - .2 BACnet Data Archive Server shall support at a minimum the following BACnet Interoperability Building Blocks (BIBBs) as supported by a submitted PICS:
 - .1 Data Sharing-ReadProperty-A (DS-RP-A).
 - .2 Data Sharing-ReadProperty-B (DS-RP-B).
 - .3 Data Sharing-ReadPropertyMultiple-A (DS-RPM-A).
 - .4 Data Sharing-ReadPropertyMultiple-B (DS-RPM-B).
 - .5 Data Sharing-WriteProperty-A (DS-WP-A).
 - .6 Trending-Automated Trend Retrieval-A (T-ATR-A).
 - .7 Trending-Automated Multiple Value Retrieval-A (T-AMVR-A).
 - .8 Trending-Archival-A (T-A-A).
 - .9 Device Management-Dynamic Device Binding-A (DM-DDB-A).
 - .10 Device Management-Dynamic Device Binding-B (DM-DDB-B).
 - .11 Device Management-Dynamic Object Binding-B (DM-DOB-B).
- .3 Online Help. The BACnet data archive software shall provide a context-sensitive online help system to assist the user in operation and modification of the system.
- .4 Provide flexible trending allowing real-time, historical, or archived data to be trended in a variety of formats. In addition, trend data types shall be combined to allow for comparisons between data, e.g., current real-time data versus archived data. The system shall provide trending capability with the following functions
- .5 It shall be possible to trend at least 500 control points continuously for at least 30 days. It shall be possible to set the trend length and frequency ie: 1 second, 5 second, 1 minute, COV etc...

2.9 OPERATOR SECURITY AND SIGN ON

- .1 Each operator shall be assigned a user profile that defines the following:
 - .1 Security and control level
 - .2 Operator identifier
 - .3 Unique password
 - .4 Area assignment and area profile
 - .5 Start graphic for that operator
 - .6 Timeout value for that operator

- .2 Actions initiated by the operator shall be logged in the event database by operator identifier. In addition, any control actions to a given point shall only be allowed if the control level configured in the operator's profile exceeds the level assigned to the controlled point.
- .3 Utilities shall allow administration of the operator passwords.
- .4 The system shall support at least six levels of operator security. The functions allowed from each security level shall be as follows:
 - .1 Level 1: Signed off mode—View start-up display only.
 - .2 Level 2: View only—The operator shall be able to view displays. Typically used for an inexperienced operator.
 - .3 Level 3: Permit all Level 1 and 2 functions and, in addition, permit the operator to control points such as start and stop, and disable and enable, and to acknowledge alarms as they occur.
 - .4 Level 4: Permit all Level 1 through Level 3 functions, in addition to the following: access master time schedules, allocate system peripherals, change point engineering parameters, build reports, and use most standard system configuration displays. This level shall be reserved for the building supervisor.
 - .5 Level 5: Permit all Level 1 through Level 4 functions, in addition to accessing engineering functions, such as building and linking displays, and allocating keyboard push button assignments. Reserved for the building consultant/engineer.
 - .6 Level 6: This is the highest level of station security. It shall allow the user unlimited access to all station functions. Reserved for the building manager.
- .5 Operator shall be permitted to sign on to the system if the correct operator identity and password have been entered. This password shall be encrypted. System shall be linked to Windows so that the operator uses their Windows account name and password to sign on to the system.
- .6 Primary access User access to the BAS will be through Web browser interface from any Operator Workstation connected to the BAS network:
 - Operator interface shall be available through a web browser. Using a browser such as Microsoft's Internet Explorer, an operator shall be able to perform all functions on the same standard and custom graphics as used in the standard operator interface. Custom graphics, alarm graphics, and standard graphics shall be available without modification or reengineering through a browser user interface and be fully functional
 - Browser interface shall not rely on java or flash programs for operation and shall be compatible with the following systems:
 - Blackberry
 - iOS devices such as iPad, iPhone, iMac, iPad, PowerMac etc...
 - Android Devices
 - Browser interface shall provide login and security authentication in the same way as the standard operator interface. It shall be possible to operate the facility through the browser user interface in the same way as the standard user interface and to perform all functions described (operator functions)' for example, acknowledge alarms, view graphics, control points, execute reports, and modify configuration settings.

2.10 CONTROLLERS

- .1 Provide an adequate quantity and types of controllers to achieve the performance specified in the System Performance and as required to provide the controls shown on the drawings and to meet the Sequence of Operation. In general the controllers shall;
 - .1 Provide at a minimum 1 Building Level networked IP controller in M&E spaces
 - .2 Provide additional Building Level and Unitary controllers in services spaces as required to

meet the requirements of the controls system

- .2 Controller shall support manual overrides and provide colored status LED's to distinguish analog and digital outputs, changing status, and analog output signal strength.
- .3 Serviceability: Provide CPU diagnostic LEDs for normal, system error, transmit, receive, ground loop, LonWorks/BACnet service, and communications bus transmit and receive. Wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
- .4 All Controllers used shall have an additional 15% points available for use. The additional points to be divided between analogue and digital inputs and outputs. Universal points are acceptable. Expansion boards installed to achieve this are acceptable as well. The cost for connection to and use of these additional points is not carried as part of this tender.
- .5 Environment. All controllers shall be suitable for permanent installation in conditioned spaces and shall be rated for operation at -20°C to 55°C (-4°F to 131°F).
 - .1 All controllers shall be suitable for permanent installation in the design location and ambient conditions.
 - .2 Controllers shall not be installed outdoors or in wet conditions.
- .6 Power & Noise. All controllers shall be able to operate at 90% to 110% of the nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.
 - .1 Controllers shall be certified in compliance with FCC/ICES-003 CFR47 Part 15/B.
- .7 Serviceability. All controllers shall be provided with diagnostic LEDs to indicate power, communication, and processor status.
- .8 Memory. All controllers shall have sufficient memory to support the operating system, database, and programming necessary to satisfy the specified Sequence of Operation and to comply with the requirements of all applicable System specifications.
 - .1 Battery/capacitor shall maintain runtime values and clock memory following a loss of power for a minimum of 72 hours.
 - .2 The database and programming shall be maintained without power for a minimum of 10 years.
 - .3 All application programs shall be stored on individual controllers in non-volatile memory.
- .9 Communication Port. Each individual DDC controller shall provide a communication port for the connection of an operator workstation.
- .10 Universal Inputs. All physical inputs on all controllers shall support at a minimum the following physical characteristics:
 - .1 Thermistor.
 - .2 Dry-contact.
 - .3 Current (4-20 mA).
 - .4 Voltage (0-10 VDC).
 - .5 150 Hz pulse counting.
 - .6 12-bit A/D resolution.
 - .7 24 VAC over-voltage protection.
- .11 Outputs. Physical outputs on all controllers shall support at a minimum the following physical characteristics:
 - .1 Universal (0-12 VDC; 75 mA @ 12 VDC).
 - .2 12-bit D/A resolution.

- .3 24 VAC over-voltage and short protection.
- .12 Database. All controller programming, configuration, and modification shall be accomplished via the internetwork from the B-AWS. The complete operational database and application program shall reside in each individual controller.
 - .1 Each controller shall provide microprocessor-based, self-contained, stand-alone, fully-programmable operation of local process control loops.
 - .2 All controllers shall function in a real-time, multitasking, networked operating environment; able to display database values, programs, and control loops in real-time while functional and simultaneously available to the operator online from the B-AWS, B-OWS, or B-OD.
- .13 Programmability. All controllers shall be freely-programmable and support custom control strategies, programs, and databases that are completely modifiable over the BACnet internetwork once installed.
 - .1 All controllers delivered as a part of this specification shall be programmed using one (1) common programming language, means, and method via the B-AWS or enterprise B-OWS. Devices that require separate custom applications for programming shall not be acceptable.
 - .2 Application specific and/or configurable devices are strictly prohibited.
- .14 Schedules. All controllers shall support the standard BACnet Schedule and BACnet Calendar objects.
 - .1 Schedule objects shall reside in each individual device.
 - .2 Applications requiring schedule objects and/or parameters to be stored exclusively on a workstation or server shall be strictly prohibited.
 - .3 All controllers shall support binary, analog, and multi-state BACnet Schedule objects.
- .15 Trend Logs. All controllers shall locally perform and manage historical data collection.
 - .1 All controllers shall support:
 - .1 The BACnet Trend Log object.
 - .2 The BACnet Trend Log Multiple object.
 - .3 Change Of Value (COV) trending.
 - .2 All trend log data shall be stored in non-volatile memory and be preserved through loss of power.
 - .3 All objects (both hardware and software) system-wide shall be assignable to user-definable trend logs with configurable sample rates and length.
 - .4 Trend log data shall be stored at each individual controller, and uploaded to hard disk storage by a BTL-Listed BACnet device dedicated for this service when long-term archiving is required.
- .16 Runtime Logs. All controllers shall support logging and reporting of runtime for every binary object in the system.
 - .1 Runtime data shall be sampled and stored in each individual BACnet device using standard BACnet objects and published properties. A workstation shall not be required for storage of custom runtime logs.
- .17 Operator Displays. All controllers featuring an operator display shall be aesthetically pleasing and specifically designed for permanent installation in a finished, occupied space.
- .18 Communicating Sensors. All controllers, except as expressly permitted below, shall support and be capable of monitoring and controlling a network of communicating sensors without consuming physical hardware input/output points on the device.
 - .1 A minimum of four (4) communicating sensors shall be supported by each DDC

- controller.
- .2 Space mounted terminal unit controllers with fewer than four (4) inputs and four (4) outputs shall not be required to support communicating space sensors.

- .19 Alarm Annunciation. All IP-enabled controllers shall support Simple Mail Transfer Protocol (SMTP) and provide stand-alone remote annunciation of alarms via e-mail without additional hardware or software.

2.11 BUILDING LEVEL EQUIPMENT CONTROLLERS

- .1 Building-level system controllers shall be provided in compliance with the requirements for Controllers and as required to achieve the performance prescribed in this specification as designated.
 - .1 Building-level system controllers are responsible for the control of major mechanical systems and central plants.
 - .2 Building-level system controllers are responsible for the execution of global strategies, systems and protocol integration, and network routing/management.
- .2 BACnet Device Profile. Building-level system controllers shall be certified and Listed by the BACnet Testing Laboratories (BTL) in compliance with the minimum requirements of ANSI/ASHRAE Standard 135-2012 Revision 14 Annex L a minimum of 30 days prior to the bid date for this project as follows:
 - .1 BACnet Building Controller (B-BC).
- .3 BACnet Networking. Building-level system controllers shall natively support the following BACnet data links as specified in ANSI/ASHRAE Standard 135 and in compliance with the following physical layer standards at a minimum:
 - .1 BACnet/IP: ANSI/ASHRAE Standard 135 Annex J.
 - .1 ISO 8802.3 Ethernet (10/100 BaseT).
 - .2 ISO 8802-3 (Ethernet): ANSI/ASHRAE Standard 135.7.
 - .1 ISO 8802.3 Ethernet (10/100 BaseT).
 - .3 Master Slave Token Passing (MS/TP): ANSI/ASHRAE Standard 135.9.
 - .1 TIA-485.
- .4 Modbus Networking. Building-level system controllers shall natively support the following Modbus data links in compliance with the following physical layer standards at a minimum:
 - .1 Modbus/TCP as a Master or Slave.
 - .1 ISO 8802.3 Ethernet (10/100 BaseT).
 - .2 Modbus/RTU as a Master or Slave.
 - .1 TIA-485.
- .5 Universal Inputs. Building-level system controllers shall be provided with a minimum of twelve (12) universal inputs dedicated for the connection of field devices compliant with the requirements for all controllers.
 - .1 The total number of universal inputs connected to the building-level system controller shall be capable of being increased to a minimum of 96.
- .6 Outputs. Building-level system controllers shall be provided with a minimum of eight (8) physical outputs dedicated for the connection of field devices. In addition to the requirements for universal outputs on all controllers, building-level system controllers shall also support at a minimum the following physical characteristics:
 - .1 Relay (500 mA @ 24 VAC/VDC).
 - .2 TRIAC (500 mA @ 24 VAC).
 - .3 The total number of universal outputs connected to the building-level system controller

shall be capable of being increased to a minimum of 64.

2.12 UNITARY CONTROLLERS

- .1 Field-level equipment controllers shall be provided in compliance with the requirements for Controllers and as required to achieve the performance prescribed in this specification as designated.
 - .1 Field-level equipment controllers are responsible for control of individual equipment that comprises mechanical systems.
 - .2 Field-level equipment controllers are responsible for control of individual equipment that executes indoor environmental quality control and monitoring strategies.
 - .3 Field-level equipment controllers are responsible for the execution of global and local strategies, and local device integration.
- .2 BACnet Device Profile. Field-level equipment controllers shall be certified and Listed by the BACnet Testing Laboratories (BTL) in compliance with the minimum requirements of ANSI/ASHRAE Standard 135-2012 Revision 14 Annex L a minimum of 30 days prior to the bid date for this project as follows:
 - .1 BACnet Building Controller (B-BC).
- .3 BACnet Networking. Field-level equipment controllers shall natively support the following BACnet data links as specified in ANSI/ASHRAE Standard 135 and in compliance with the following physical layer standards at a minimum:
 - .1 BACnet/IP: ANSI/ASHRAE Standard 135 Annex J.
 - .1 ISO 8802.3 Ethernet (10/100 BaseT),
 - .2 ISO 8802.3af PoE (10/100 BaseT), or
 - .3 ISO 8802.11b/g/n Wi-Fi.
 - .2 ISO 8802-3 (Ethernet): ANSI/ASHRAE Standard 135.7.
 - .1 ISO 8802.3 Ethernet (10/100 BaseT),
 - .2 ISO 8802.3af PoE (10/100 BaseT).
 - .3 Master Slave Token Passing (MS/TP): ANSI/ASHRAE Standard 135.9.
 - .1 TIA-485.
- .4 Power & Noise. In addition to the power and noise requirements for all controllers, field-level equipment controllers shall also support the following physical power link:
 - .1 ISO 8802.3af PoE.
- .5 Universal Inputs. Field-level equipment controllers shall be provided with a minimum of six (6) software-selectable universal inputs dedicated for the connection of field devices compliant with the requirements for all controllers.
- .6 Integral Sensors. In addition to universal inputs dedicated for the connection of field devices, field-level equipment controllers shall support the following integral sensors at a minimum:
 - .1 Temperature.
 - .1 Resolution: ± 0.1 °C (0.18 °F).
 - .2 Accuracy: ± 0.1 °C (0.18 °F).
 - .2 Relative Humidity.
 - .1 Range: 10-90 %RH.
 - .2 Resolution: ± 0.1 %RH.
 - .3 Accuracy: ± 3 %RH.
 - .3 CO₂.
 - .1 Range: 400-2000 ppm.
 - .2 Accuracy: ± 35 ppm.
 - .3 Non-Linearity: < 1% of full scale.

- .4 Technology: Non-Dispersive Infrared Optical Sensor.
- .4 Occupancy.
 - .1 Range: 5 m (16.4').
 - .2 Angle: 100° horizontal/82° vertical.
 - .3 Technology: Passive Infrared Radiation (PIR).
- .5 All integral sensors shall comply with the System performance criteria detailed elsewhere in this specification.
- .7 Outputs. Field-level equipment controllers shall be provided with a minimum of six (6) jumper-selectable physical outputs dedicated for the connection of field devices. In addition to the requirements for universal outputs on all controllers, building-level equipment controllers shall also support at a minimum the following physical characteristics:
 - .1 Solid state relay (500 mA @ 24 VAC/VDC).
 - .1 The act of switching must not produce an audible noise discernable to the occupants of the space where the device is installed.

2.13 INPUT AND OUTPUT INTERFACE

- .1 Hardwired inputs and outputs may tie into the system through general purpose, custom application, unitary controllers or distributed I/O devices.
- .2 Input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to controller. Input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no damage to controller. Inputs and outputs shall be arranged on interchangeable modules or circuit boards to allow the replacement of a damaged module or board without replacing the entire controller.
- .3 Digital inputs shall allow the monitoring of on and off signals from remote devices. Digital inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices, and shall be protected against the effects of contact bounce and noise. Digital inputs shall sense dry contact closure without external power other than that provided by the controller being applied.
- .4 Analog inputs for GPCs shall be minimum 12-bit resolution and allow the monitoring of low-voltage (0 to 10 VDC), current (0 to 20 mA), negative temperature coefficient (NTC), and resistance temperature detector (RTD). Analog inputs shall be compatible with and field-configurable to commonly available sensing devices. To prevent thermal loading, RTDs and thermistors shall be scanned rather than have continuous power applied.
- .5 Inputs shall be electrically isolated from their associated field points.
- .6 Digital outputs shall provide for on and off operation, or a pulsed low-voltage signal for pulse width modulation control. Outputs shall be selectable for either normally open or normally closed operation.
- .7 Analog outputs shall be minimum 8-bit resolution and provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs on general purpose or custom application controllers shall have status lights and a two-position Auto and Manual switch and manually adjustable potentiometer with feedback for manual operation. Analog outputs shall not exhibit a drift of greater than 0.4 percent of range per year.
- .8 Tri-State outputs: Provide tri-state outputs (two coordinated digital outputs) for control of three-point floating-type electronic actuators without feedback. Use of three-point floating devices shall

be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation). Control algorithms shall run the zone actuator to one end of its stroke every 24 hours for verification of operator tracking.

2.14 CONTROL PANEL ENCLOSURES

- .1 Temperature Control Panels. Pedestal base or wall mounted local control enclosures to be fully enclosed NEMA 1 (IEC IP20) at a minimum with hinged door, key-lock latch, and removable subpanels to house all control components appropriate to the environment, service, and/or as required by the code enforcing authorities and other AHJ.
 - .1 All enclosures shall be UL-Listed.
 - .2 Enclosures in mechanical rooms shall meet NEMA 2 (IEC IP21) requirements at a minimum or as directed by the AHJ.
 - .3 Enclosures in all locations not requiring NEMA 2 (IEC IP21) including occupied spaces, above ceilings, and plenums shall be the same NEMA (IEC) classification as other enclosures located in the same environment, except if location requires additional protection due to potential vandalism or environmental conditions or as directed by the AHJ.
 - .4 Enclosures exposed to moisture, in wet mechanical rooms or located outdoors shall be meet NEMA 4X (IEC IP66) requirements or as directed by the AHJ.
 - .5 Unless otherwise required by local codes and/or AHJ, all enclosures shall be a minimum of 16-gauge steel or aluminum, totally enclosed on all sides and powder coated or painted with a baked enamel finish.

2.15 BUILDING AUTOMATION SYSTEM FIELD CONTROL DEVICES

- .1 Electric damper and valve actuators:
 - .1 Actuator shall have mechanical or electronic stall protection to prevent damage to the actuator through the rotation of the actuator.
 - .2 Where shown, for power-failure and safety applications, an internal mechanical spring-return mechanism shall be built into the actuator housing.
 - .3 Rotary spring-return actuators shall be capable of clockwise or counter-clockwise spring-return operation. Linear actuators shall spring-return to the retracted position.
 - .4 Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range
 - .5 Floating Signals are not acceptable.
 - .6 Power. All 24 VAC/VDC actuators shall operate on Class 2 circuits.
 - .7 Position Feedback. All actuators shall feature a visual position feedback indicator. All non-terminal unit actuators shall provide a 2-10 VDC or 4-20 mA feedback signal.
 - .8 Actuators shall be by Belimo. Refer to Mechanical Schedules.
 - .9 Non-spring-return actuators shall have an external manual gear release to allow manual positioning of damper when actuator is not powered. Spring-return actuators with more than 7 N.m [60 in-lb.] torque capacity shall have a manual crank for this purpose.
 - .10 Modulating actuators shall have an external, built-in switch to allow reversing of rotation direction.
 - .11 Provide actuators with a raceway fitting and a minimum 1m electrical cable pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
 - .12 Actuators shall be UL Standard 873 Listed as meeting correct safety requirements and recognized industry standards.
 - .13 Actuators shall be designed for a minimum of 60,000 full-stroke cycles at the actuator's rated torque and 1.5 million repositions.
 - .14 Enclosure. Actuator casing and/or enclosures shall be appropriate to the application.
 - .1 Actuator housings shall be NEMA 2 and plenum rated.

- .2 Actuators used in or near outdoor air streams shall have IEC IP21 (NEMA 2) housings.
- .3 Actuators exposed to moisture, in wet mechanical rooms, or located outdoors shall be meet IEC IP66 (NEMA 4X) requirements or as directed by the AHJ.
- .2 Control valves:
 - .1 Control valves shall be two-way or three-way type for two-position or modulating service as shown. Unless otherwise indicated, all valves shall have a minimum rangeability of 50:1.
 - .2 Close-Off/Differential Pressure Rating. All valves shall be guaranteed to have not more than 1% leakage of design flow rate at the pump shut-off pressure. All valve actuators and trim shall be furnished to provide the following minimum close-off pressure ratings unless otherwise specified or scheduled:
 - .1 Two-way: 200 percent of total system (pump) head.
 - .2 Three-way: 300 percent of pressure differential between ports A and B at design flow or 100 percent of total system (pump) head.
 - .3 Steam valves: 200 percent of operating (inlet) pressure.
 - .3 Water valves:
 - .1 Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, in compliance with the following at a minimum:
 - .1 Equal percentage ports for modulating service.
 - .2 Valve bodies shall meet or exceed pressure and temperature class rating based upon design operating temperature and 150% design operating pressure. Unless otherwise specified or scheduled, minimum body rating for any valve is 860 kPa (125 psi) and a maximum fluid temperature of 177°C (350°F).
 - .3 Valves shall have stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation.
 - .4 Globe valves shall have replaceable seats.
 - .2 Water Valves. Unless otherwise specified or scheduled, water valves shall follow the following criteria:
 - .1 Two-position service: Line size, unless otherwise shown.
 - .2 Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50 percent of the pressure difference between supply and return mains, or 5 psi, whichever is greater.
 - .3 Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa [5 psi] maximum.
 - .4 Valves ½ inch through 2 inch shall be bronze body or cast brass ANSI Class 250, spring-loaded, O-ring seal, EPDM packing, quick opening for two-position service. Two-way valves to have replaceable composition disc, or stainless steel ball.
 - .5 2 ½ inch valves and larger shall be cast iron ANSI Class 125 with guided plug and EDPM O-ring or Teflon packing, unless otherwise shown.
 - .3 Water valves shall fail normally open or closed as scheduled on plans, or as follows:
 - .1 Water zone valves—normally opened preferred.
 - .2 Heating coils in air handlers—normally open.
 - .3 Chilled water control valves—normally closed.
 - .4 Other applications—as scheduled or as required by sequences of operation.

- .3 Temperature sensors:
 - .1 Temperature sensors shall be analogue precision element thermistor type.
 - .2 Duct Sensors. Duct temperature sensors shall include junction box for wiring connections and gasket to prevent air leakage and vibration noise.
 - .1 Single point duct temperature sensor probe shall consist of 316 stainless steel extending to the center of the duct.
 - .2 Averaging duct temperature sensor shall consist of a copper or stainless-steel averaging element. Averaging sensors shall be a minimum of 1.5 m (5') in length per 1 m² (10 ft²) of duct cross sectional area.
 - .3 Immersion Sensors. Liquid immersion temperature sensor shall be provided with a separable stainless steel well. The well must be designed to be consistent and appropriate with the system operating pressure and velocity.
 - .4 Space Sensors. Space temperature sensor shall consist of an element within a ventilated cover aesthetically pleasing and specifically designed for permanent installation in a finished, occupied space.
 - .1 Refer to drawings and schedules for space sensor types and locations
 - .2 In private and semi-private spaces that serve full-time or full-time-equivalent occupants including but not limited to offices, work rooms, meeting rooms, conference rooms, etc., space sensors shall be provided with setpoint adjustment and occupancy bypass. Bypass not required in zones with occupancy sensors or applications that are constantly occupied.
 - .3 In public spaces without full-time or full-time-equivalent occupants including but not limited to lobbies, hallways, atriums, break rooms, cafeterias, restrooms, theaters, gymnasiums, mechanical spaces, plenums, etc., simple temperature sensor without setpoint or bypass shall be provided.
 - .4 Sensors with operator interface keypads and displays shall be provided as indicated or scheduled elsewhere.
 - .5 Where sensors are noted on the drawings as Ta, the product shall be similar to Reliable SMART-Sensor – SS3-E – 'XX' where XX is for options, i.e. CO2 where applicable
 - .6 Where sensors are noted on the drawings as Tb, the product shall be similar to Honeywell C7772A1012.
 - .7 Where sensors are noted on the drawings as Tc, the sensors are to be provided with equipment by the vendor and installed by Div. 25.
 - .8 Where sensors are noted on the drawings as Td, the sensors are to be provided by the equipment vendor as noted in the schedules and installed by Div. 25 in accordance with the manufacturer's instructions.
 - .5 Outdoor Air Temperature. Outdoor air temperature sensor shall consist of a single device sensor, ventilated non-metallic sun shield, utility box for terminations, and watertight gasket to prevent water seepage.
 - .6 Differential Temperature. Provide matched sensors for differential temperature applications.
 - .7 Low-Limit Thermostats. Low-limit airstream thermostats shall be UL-Listed, vapor pressure type, with an element of 6 m (20') minimum length.
 - .1 Provide one (1) low-limit thermostat for each 2 m² (20 ft²) of coil face.
 - .2 Low-limit thermostat shall respond to the lowest temperature sensed in by any 30 cm (12") section of the element.
 - .3 Low-limit thermostats shall be manual-reset, DPDT-style with a minimum of one (1) normally-open contact and one (1) normally-closed contact.
 - .8 High-Limit Thermostats. High-limit airstream thermostats shall be UL-Listed, bimetal-operated, manual reset type.
 - .9 Low-voltage Thermostats. Low-voltage thermostats shall be 24 VAC, bimetal-operated or electronic type with adjustable fixed anticipation heater, concealed setpoint adjustment

- 13-30°C (55-85°F) setpoint range, 1°C (2°F) maximum differential and vented ABS plastic housing.
- .10 Line-voltage Thermostat. Line-voltage thermostats shall be UL-Listed bi-metal actuated, open contact type, enclosed, snap-switch type or equivalent solid-state type with adjustable of fixed anticipation heater, concealed setpoint adjustment 13-30°C (55-85°F) range, 1°C (2°F) maximum differential, and vented ABS plastic housing.
- .4 Humidity sensors:
- .1 Duct Sensors. Duct-mounted humidity sensors shall have a sensing range of 20% to 80% RH and shall be provided with a sampling chamber.
- .2 Space Sensors. Space sensors shall have a sensing range of 20 to 90% RH.
- .3 Outdoor Air Sensors. Outdoor air humidity sensors shall have a sensing range of 20 to 95% RH and shall be suitable for ambient conditions of -40°C to 75°C (-40°F to 170°F).
- .4 Drift. Sensor drift shall not exceed 1% of full scale per year.
- .5 Flow switches:
- .1 Flow-proving switches shall be either paddle or differential pressure type, as shown.
- .2 Paddle type switches (water service only) shall be ULC/CSA Listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 7 enclosure unless otherwise specified. Honeywell MAMFS43 or equivalent or as specifically shown on the drawings.
- .3 Differential pressure type switches (air or water service) shall be ULC/CSA Listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 2 enclosure, with scale range and differential suitable for intended application, or as specified.
- .6 Relays:
- .1 Control relays shall be CUL/CSA Listed plug-in type.
- .2 Control relays shall be CUL/ CSA Listed, enclosed with LED energized indicator. Contact rating, configuration, and coil voltage shall be suitable for application. Coil current shall be less than 50 mA.
- .3 Time delay relays shall be CU/CSA Listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable $\pm 200\%$ (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage suitable for application.
- .4 Provide NEMA 1 enclosure when not installed in local control panel.
- .7 Current transmitters:
- .1 AC current transmitters shall be self-powered combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4 to 20 mA two-wire output. Unit ranges shall be 10 A, 20 A, 50 A, 100 A, 200 A, and 200 A full scale, internal zero and span adjustment, and ± 1 percent full-scale accuracy at 500 ohm maximum burden.
- .2 Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be ULC/CSA Recognized.
- .3 Unit shall be split-core type for clamp-on installation on existing wiring.
- .8 Current transformers:
- .1 AC current transformers shall be ULC and CSA recognized and completely encased (except for terminals) in approved plastic material.
- .2 Transformers shall be available in various current ratios and shall be selected for ± 1 percent accuracy at 5 A full scale output.
- .3 Transformers shall be split-core type for installation on new or existing wiring, respectively.
- .9 Voltage transmitters:

- .1 AC voltage transmitters shall be self-powered single loop (two-wire) type, 4 to 20 mA output, with zero and span adjustment.
 - .2 Ranges shall include 100 to 130 VAC, 200 to 250 VAC, 250 to 330 VAC, and 400 to 600 VAC full-scale, adjustable, with ± 1 percent full-scale accuracy with 500 ohm maximum burden.
 - .3 Transmitters shall be ULC/CSA Recognized at 600 VAC rating and meet or exceed ANSI/ISA S50.1 requirements.
- .10 Voltage transformers:
- .1 AC voltage transformers shall be ULC and CSA recognized, 600 VAC rated, complete with built-in fuse protection.
 - .2 Transformers shall be suitable for ambient temperatures of +4 degrees C to +55 degrees C [+40 to +130 degrees F] and shall provide ± 0.5 percent accuracy at 24 VAC and a 5 VA load.
 - .3 Windings (except for terminals) shall be completely enclosed with metal or plastic material.
- .11 Current switches:
- .1 Current Switches. Current-operated switches shall be UL-Listed self-powered, solid-state, split-core type with adjustable trip current, status LED, and dry-contact output.
 - .2 Select switches to match the current of the application and output requirements of the DDC system.
- .12 Pressure transducers:
- .1 Transducers shall have linear output signal. Zero and span shall be field-adjustable.
 - .2 Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50 percent greater than calibrated span without damage.
 - .3 Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 200 psi minimum. Transducers shall be complete with 4 to 20 mA output, required mounting brackets, and block and bleed valves.
 - .4 Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 200 psi minimum. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and;
 - .1 Gauge water pressure transducers shall be provided with block and bleed valves.
 - .2 Differential water pressure transducers over-range differential pressure limit and maximum static pressure shall be 2 MPa (300 psi).
 - .3 Differential water pressure transducers shall be provided with five-valve manifold for isolation, bypass and bleed.
- .13 Pressure switches:
- .1 Differential-pressure-type switches (air or water service) shall be ULC listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application, or as shown.
 - .2 Snubbers shall be provided for all water pressure transducer/switch connections to prevent system pressure hammers and surges from being fully transmitted to the pressure sensor.
- .14 CO₂ Carbon dioxide sensors:
- .1 Sensing of carbon dioxide shall incorporate the NDIR—non-dispersive infrared—sensing method. Sensor shall incorporate sampling tubes for duct mounting and have optional LCD readout. Range of sensing shall be 0-2000 PPM and field adjustable 0-1000 PPM, 0-2000PPM, 500-2000PPM, and 500-2000PPM, with an accuracy of ± 75 PPM from 0 to 2000 PPM and ± 5 percent above 2000 PPM. Annual drift shall be (20PPM nominal) and

- have a calibration interval of five years recommended. Output shall be 4-20 mA and have an operating temperature range of +32 to +122 degrees F and 0 to 95 percent RH, non-condensing.
- .2 manifold.

.15 Water Leak Detectors

- .1 KELE WD-18 – 24VAC supply power, N/C relay for output to BAS. Floor Mounted with Gold Plated probes

2.16 POWER SUPPLIES AND LINE FILTERING

- .1 Power Supplies & Control Transformers. Control transformers and power supplies shall be UL-Listed. Provide Class 2 current-limiting type or over-current protection in both primary and secondary circuits for Class 2 service not to exceed 100 VA in accordance with the applicable following requirements or as directed by the AHJ.
 - .1 Ontario Electrical Safety Code (CSA C22.1-18 and Ontario amendments to the code) Rule 16-200.

2.17 INTERCONNECTING WIRING & RACEWAYS

- .1 Wiring & Cable. All wiring regardless of service and/or voltage shall comply with the Contract Document Electrical System Specifications, CSA C22.1-18 and any/all applicable local codes and/or Authorities Having Jurisdiction (AHJ).
 - .1 All insulated wire to be copper conductors, UL labeled for 90 °C minimum service.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Consultant for resolution before rough-in work is started.
- .2 Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Consultant for resolution before rough-in work is started.

3.2 PROTECTION

- .1 Contractor shall protect work and material from damage from its work or employees, and be liable for all damages thus caused.
- .2 Contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted. Contractor shall protect material that is not immediately installed. Contractor shall close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

- .1 Submittals: Refer to Submittals Article in Part 1 of this Specification for requirements.
- .2 Test and balance:
 - .1 Contractor shall furnish all tools necessary to interface to the control system for test and

- balance purposes.
 - .2 Contractor shall provide training in the use of these tools. This training will be planned for a minimum of four hours.
 - .3 In addition, the contractor shall provide a qualified technician to assist in test and balance process, until the first 20 terminal units are balanced.
 - .4 Tools used during the test and balance process will be returned at completion of the testing and balancing.
- .3 Coordination with controls specified in other sections or divisions: Other sections and divisions of this Specification include controls and control devices that are to be part of or interfaced to control system specified in this section. Controls shall be integrated into the system and coordinated by contractor as follows:
- .1 Communication media and equipment shall be provided as specified in Part 2: Communication of this Specification.
 - .2 Each supplier of a control product is responsible for the configuration, programming, startup, and testing of that product to meet the sequences of operation described in this section.
 - .3 Contractor shall coordinate and resolve any incompatibilities that arise between the control products provided under this section and those provided under other sections or divisions of this Specification.
 - .4 Contractor is responsible for providing all controls as referenced in the related sections this work of contract documents.
 - .5 Contractor is responsible for the interface of control products provided by multiple suppliers, as referenced in the related sections this work of contract documents.

3.4 GENERAL WORKMANSHIP

- .1 Install equipment, piping, and wiring raceway parallel to the building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- .2 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- .3 Install equipment in readily accessible locations as defined by OESC.
- .4 Verify wiring integrity to ensure continuity and freedom from shorts and grounds.
- .5 Equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility, and be executed in strict adherence to local codes and standard practices.

3.5 CONTROL PANELS

- .1 Unless otherwise directed by the Consultant or AHJ, all control panels and enclosures shall be located in mechanical/electrical rooms and installed such that visual observation and adjustment can be accomplished while standing flatfooted on the floor in a convenient location adjacent to the equipment served. Install all equipment in readily accessible location as defined by Chapter 1 Article 100 Part A of the NEC or CSA C22.1-12 Rule 2 (as applicable).
- .2 All control panels shall have keyed, locking latches and shall be keyed commonly such that one key shall open all enclosures.
- .3 Provide each DDC panel with a surge suppressor, electrical disconnect, control fuse, and control transformer; all sized and provided by the System Contractor.

- .4 Interconnections between internal termination points and face and/or panel-mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL-Listed for 600-volt service, individually identified per control drawings with adequate clearance for field connections.
 - .1 Provide insulated, modular, feed-through, clamp-style recessed captive screw-type terminal blocks suitable for rail-mounting with end plates and partitions for the termination of all field wiring in temperature control panels.
 - .2 Field wiring to equipment with integral terminals and/or unitary equipment shall not be required to have terminal blocks.
- .5 All high-voltage wiring consistent with the definitions of NEC/CSA Class 1 must be strictly separated by barriers, raceways or sub-panels from low-voltage wiring consistent with the definitions of NEC/CSA Class 2 according to the requirements of the NEC Chapter 7 Article 725 – Class 1, Class 2 and Class 3 Remote-Control, Signaling and Power-Limited Circuits and the CSA Canadian Electrical Code, Part 1 Rule 16-212 Separation of Class 2 circuit conductors from other circuits.
- .6 Provide laminated nameplates or tags for all control system components. Unless otherwise directed in this specification or by the AHJ, nameplates shall be minimum 1 inch by 3 inches (2.5 cm X 7.5 cm), with minimum ¼ inch (6 mm) high block lettering. Nameplates for devices smaller than 1 inch by 3 inches (2.5 cm X 7.5 cm) shall be attached to adjacent surface or connected to the device using a chain.
- .7 A legible reproduction of the “As-built” application engineering for the system served shall be laminated in clear plastic and mounted within each enclosure.
- .8 Power supplies and line filtering. No loads shall exceed 80% of faceplate rating for each power supply or transformer

3.6 INSTALLATION OF FIELD DEVICES

- .1 Installation of sensors
 - .1 Install sensors in accordance with the manufacturer's recommendations.
 - .2 Mount sensors rigidly and adequately for the environment within which sensor operates.
 - .3 Space sensors shall be installed on concealed junction boxes properly supported.
 - .4 All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings. Where necessary due to structural cavities, masonry walls, proximity to exterior openings, unconditioned spaces, etc. insulated mounting base shall prevent temperature of mounting location from affecting sensor temperature reading.
 - .5 Wiring to the sensor shall not be required to be polarity sensitive. Design of sensor shall be modular, which allows for rough-in of wiring without presence of electronics or esthetic covering.
 - .6 Sensors used in mixing plenums and in hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.
 - .7 Install low-limit sensors used in mixing plenums in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 1 ft of sensing element for each square ft of coil area.
 - .8 Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells. Assembly shall allow removal of sensor from well without loss of measured medium fluid.
 - .9 Outdoor air sensors shall be mounted outside on a northern exposure as high as

- serviceable on the building. The sensor shall be mounted within a ventilated enclosure to shield the sensor from the effects of the sun. The sensor location shall be selected such that it may not be affected by artificial and/or mechanical airstreams (i.e., building exhaust, building relief, etc.).
- .10 In condensing environments use stainless steel sensing element and capillary mounting clips.
 - .11 Sensor guards shall be provided to protect sensor from damage in high-impact and/or high-traffic areas and/or where vandalism is a concern.
 - .12 Sensors shall be manually calibrated on site so that the wiring length and termination does not detract from the specified sensor accuracy.
 - .13 Differential air static pressure:
 - .1 Supply duct static pressure: Pipe high pressure tap to the duct using a pito tube. Pipe low pressure port to a tee in the high pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high pressure tap and leave open to plenum.
 - .2 Return duct static pressure: Pipe high pressure tap to the duct using a pito tube. Pipe the low pressure port to a tee in the low pressure tap tubing of the corresponding building static pressure sensor.
 - .3 Building static pressure: Pipe the low pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high volume accumulator. Pipe the high pressure port to a location behind a thermostat cover.
 - .4 Piping to pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
 - .5 Pressure transducers other than those controlling VAV boxes shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without the use of ladders or special equipment.
 - .6 Air and water differential pressure sensors shall have gauge tees mounted adjacent to all taps. Water gauges shall also have shutoff valves installed before the tee.
- .2 Flow switch installation
- .1 Use correct paddle for pipe diameter.
 - .2 Adjust flow switch in accordance with manufacturer's instructions.
- .3 Control Valves
- .1 Valves shall be installed in accordance with the manufacturer's recommendations.
 - .2 Two-way valves shall not be placed on branch or main hydronic circuits where these valves will cause a "dead-head" pumping condition.
 - .3 Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position.
 - .4 Ball type control valves shall be installed with the stem in the horizontal position.
 - .5 Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
 - .6 Isolation valves shall be installed so that the control valve body may be serviced without draining the supply/return side piping system.
 - .7 Unions shall be installed at all connections to screw-type control valves.
 - .8 Provide tags for all control valves indicating service and number.
 - .1 Tags shall be brass, 4 cm (1.5") in diameter, with 6.4 mm (1/2") high letters.
 - .2 Securely fasten with chain and hook.
 - .3 Match identification numbers as shown on approved controls shop drawings.

- .4 Actuators
 - .1 Mount and link control damper actuators per manufacturer's instructions.
 - .1 Check operation of damper and actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - .2 Provide mounting hardware and linkages for actuator installation.
 - .3 To compress seats when spring-return actuators are used on normally-closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten linkages.
 - .4 Minimum torque and power output requirements of actuators shall not be less than 125% of the required design load.
- .5 Electric and electronic actuators:
 - .1 Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. Actuators shall be mounted following manufacturer's recommendations.
 - .2 Valves: Actuators shall be connected to valves with adapters approved by actuator manufacturer. Actuators and adapters shall be mounted following actuator manufacturer's recommendations.
 - .3 Total damper area operated by an actuator shall not exceed 80 percent of the manufacturer's maximum area rating. Provide at least one actuator for each damper section. Damper actuator shall not power more than 2 m² [20 ft²] of damper.
 - .4 Use line shafting or shaft couplings (jackshafting) in lieu of blade-to-blade linkages or shaft coupling when driving axially aligned damper sections.
- .6 Flow Meters
 - .1 Mount meters such that they can be removed freely and without obstruction.
 - .2 Assembly shall allow removal of meter from piping system without loss of measured fluid.
- .7 Gas Detection System
 - .1 Install the Gas Detection System in accordance with the manufacturers recommendation inclusive of all interconnecting low voltage and network cabling as required for a complete system.
 - .2 Integrate the Gas Detection System with BAS and provide all programing and interlocks to achieve the associated sequence of operation.
 - .3 Include for manufacturer start up and calibration of all sensors
 - .4 Provide system testing and validation

3.7 FIELD QUALITY CONTROL

- .1 Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Specification.
- .2 Contractor shall continually monitor the field installation for code compliance and quality workmanship.
- .3 Contractor shall have work inspected by local or state authorities having jurisdiction over the work.

3.8 WIRING

- .1 Control and interlock wiring shall comply with national and local electrical codes and Division 26 of this specification. Where requirements of this section differ with those in Division 26, the requirements of this section shall take precedence.

- .2 Low-voltage wiring shall meet OESC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current limit.)
- .3 Where Class 2 (current limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in the raceway may be used, provided cables are ULC Listed for intended application. For example, plenums shall be ULC Listed specifically for that purpose.
- .4 Wiring in mechanical, electrical, or service rooms—or where subject to mechanical damage—shall be installed in raceway at levels below 3m [10ft].
- .5 Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two.
- .6 Do not install wiring in raceway containing tubing.
- .7 Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it, and neatly tied at 3m [10 ft] intervals.
- .8 Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
- .9 Wire-to-device connections shall be made at a terminal block or terminal strip. Wire-to-wire connections shall be made at a terminal block or wire nut at junction box.
- .10 Wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- .11 Maximum allowable voltage for control wiring shall be 24v. If only higher voltages are available, the contractor shall provide step-down transformers.
- .12 Wiring shall be installed as continuous lengths, with no splices permitted between termination points.
- .13 Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
- .14 Size of raceway and size and type of wire shall be the responsibility of contractor, in keeping with the manufacturer's recommendation and OESC requirements, except as noted elsewhere.
- .15 Include one pull string in each raceway 2.5 cm [1 inch] or larger.
- .16 Use coded conductors throughout with different colored conductors.
- .17 Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 20 cm [6inch] from high-temperature equipment (e.g., steam pipes or flues).
- .18 Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

- .19 Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of vertical raceways.
- .20 Contractor shall terminate control and interlock wiring, and maintain updated wiring diagrams with terminations identified at the job site.
- .21 Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 1m [3 ft] in length and shall be supported at each end. Flexible metal raceway less than 1/2 in. electrical trade size shall not be used. In areas exposed to moisture—including chiller and boiler rooms—liquid-tight, flexible metal raceways shall be used.
- .22 Raceway shall be rigidly installed, adequately supported, properly reamed at both ends and left clean and free of obstructions. Raceway sections shall be joined with couplings (per code). Terminations shall be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.9 COMMUNICATION WIRING

- .1 Communication and network wiring shall adhere to the Wiring article in Part 3 of this specification and the manufacturer's recommendations for all twisted pair cabling, etc.
- .2 Communication wiring shall not be installed in any raceway or conduit with Class 1 or Class 2 wiring.
- .3 All communication wiring shall be installed as continuous lengths, with no splices permitted between termination points.
- .4 All communication cabling shall be labelled to indicate origination and destination devices.
- .5 All communications shielding shall be grounded as per manufacturer's recommendations and in accordance with the OESC/CSA (as applicable).

3.10 IDENTIFICATION OF HARDWARE AND WIRING

- .1 Wiring, cabling, and tubing within factory-fabricated panels shall be labeled within 5 cm [2inch] of termination with point address or termination number.
- .2 Manufacturers' name plates and ULC or CSA labels are to be visible and legible after equipment is installed.
- .3 Identifiers shall match record documents.
- .4 Permanently label or code each point of field terminal strips to show instrument or item served.
- .5 Identify room sensors relating to terminal box or valves with nameplates.
- .6 Label wiring and conduit, including wire within panels, on both ends with device name or point address location or terminal block number.
- .7 Electrical devices such as transformers and power supplies shall be labeled with supply voltage and power circuit number.
- .8 Terminal blocks shall be labeled to match the connected device.

- .9 Label panel-mounted devices to match as built drawings.
- .10 Wire and labels shall be clearly indicated on the control drawings. Method of labeling shall be logical and intuitive.

3.11 PROGRAMMING

- .1 Provide sufficient internal memory for the specified sequences of operation and trend logging.
There shall be a minimum of 25 percent of available memory free for future use.
- .2 Point naming and point value: System point names and values shall be of sufficient size to allow flexibility in design, allowing easy operator interface without the use of a written point index or cryptic alphanumeric shorthand.
 - .1 Point ID is used to designate the location of the point within the building, such as mechanical room, wing, or level, or the building itself in a multi-building environment. Point ID shall be a minimum of 40 characters in length.
 - .2 Point descriptors shall be a minimum of 132 characters.
 - .3 Point states shall be a minimum of 8 characters in length.
 - .4 Point engineering units shall be a minimum of 6 characters in length.
 - .5 Point values shall be a minimum of 20 characters in length with a variable decimal point.
- .3 Operator interface:
 - .1 Standard graphics: Provide graphics for all mechanical systems and floor plans of the building. This includes each air handler, terminal equipment and all life safety devices. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as set points.
 - .2 Show terminal equipment information on a graphic summary table. Provide dynamic information for each point shown.
 - .3 Program graphic screens to show the location of, alarm points, and cameras. Set up these screens to provide automatic camera call up upon alarm.
 - .4 Where CCTV cameras will be used to qualify alarms, create links to allow both live and recorded viewing of the cameras through the alarm monitoring process.
 - .5 Contractor shall provide labor necessary to install, initialize, start up, and troubleshoot all operator interface software and their functions as described in this section. This includes any operating system software, operator interface database, and any third-party software installation and integration required for successful operation of the operator interface
 - .6 Division 25 contractor shall allow for 5 additional programming changes at the discretion of the consultant at no cost to the owner.

3.12 SYSTEM CHECK-OUT AND TESTING

- .1 All testing listed in this Article shall be performed by Division 25 Contractor and make up part of the necessary verification of an operating control system. Testing shall be completed before the Consultant is notified of the system demonstration.
- .2 The Contractor shall furnish all the necessary labor and test and calibration apparatus required to calibrate and prepare for service all instruments, controls, and accessory equipment provided under this specification.
- .3 Verify that all control terminations are tight, and all control wiring is proper and free from shorts and faults.
 - .1 Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation. RING OUT ALL POINTS

- .4 Enable normal operational control and verify calibration of all input devices individually according to manufacturer's recommendations.
- .5 Verify the operation of all output devices including action, normal positions, fail-safe positions, start and span, and travel.
 - .1 Verify that digital output devices (relays, solenoid valves, two-position actuators and control valves, and magnetic starters) operate properly and that normal positions are correct.
 - .2 Verify that analog output devices (I/Ps, actuators) are functional, that start and span are correct, and that direction and normal positions are correct. Contractor shall check all control valves and automatic dampers to ensure proper action and closure. Contractor shall make any necessary adjustments to valve stem and damper blade travel.
- .6 Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation.
 - .1 Tune all control loops and optimum start/stop routines.
 - .2 Check each alarm separately by providing an appropriate signal to trip the alarm.
 - .3 Trip all safeties and interlocks to verify proper operation and fail-safe response.
 - .4 Ground all circuits and verify response of trouble signals.
 - .5 Check presence and audibility of tone at all alarm notification devices.
- .7 As each device is tested, a log shall be completed showing the date, technician's initials, and any corrective action taken as a result of operational failures. This log shall be submitted prior to scheduling full system commissioning.

3.13 COMMISSIONING

- .1 Commissioning for this Division shall be performed specifically in accordance with the respective Division 1, 21, 23, 26, 28, and 25 Sections.
- .2 This Division shall coordinate efforts as required with the Commissioning Team, and other divisions to complete proper checkout and testing, and comply with all requirements set out in Section 01 91 13 and this section.
- .3 This division shall assign a Controls Commissioning Coordinator to participate in all activities as required by the commissioning team (checklist creation, meetings, scheduling, reporting, installation verification, performance verification etc...)
- .4 Prior to acceptance, control system shall undergo a series of performance tests to verify operation and compliance with this Specification. Tests shall occur after the contractor has completed the installation, started up the system, and performed its own tests.
- .5 Tests described in this section are to be performed in addition to tests that contractor performs as a necessary part of the installation, startup, and debugging process and as specified in the Control System Checkout and Testing Article in this Specification.
- .6 Coordinate with the Commissioning team to schedule the work. Notify the and coordinate the performance verification schedule with the Consultant at least 10 days in advance of the start of the testing procedures.
- .7 The Contractor shall provide at least two (2) qualified technical personnel equipped with means for two-way communication to participate in the performance verification of each system and to demonstrate the actual operation of all control operations and modes including occupied,

- unoccupied, seasonal changeover, and emergency/fail-safe operation etc as required to complete the commissioning forms.
- .8 Compliance with this specification shall be demonstrated including all specification sections, schedules, drawings, and Sequences of Operation.
 - .9 Demonstrate compliance with the controls "System Performance" requirements.
 - .10 Demonstrate operator interface compliance with the requirements of the specification.
 - .11 Demonstrate the following items:
 - .1 DDC Loop response: Contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. Test shall show the loop's response to a change in set point that represents a change in output of at least 25 percent of its full range. Sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. For each sample, the trend data shall show the process variable, set point, loop output and physical output position. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by contractor.
 - .2 Demand limiting (if implemented): Contractor shall supply a trend data output showing the action of demand limiting algorithm. Data shall document action on a minute-by-minute basis over a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
 - .3 Optimum start and stop (if implemented): Contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include output status of optimally started and stopped equipment, and area temperature sensor inputs.
 - .4 Interface to the building fire alarm system.
 - .5 Devices supplied by others connected to the system shall be checked out and commissioned by supplier, and verification of interface interoperability shall be conducted by this contractor.
 - .12 Operational logs for each system that demonstrate normal operation.
 - .1 Trends shall include the process variable, setpoint, loop output, physical output position, operational mode, and equipment status.
 - .2 Trends shall cover three (3) 48-hour periods with a sampling interval of not more than 10 minutes.
 - .13 At the discretion of the Owner/Engineer trends from a random sampling of 25% of unitary controllers/applications shall be submitted.
 - .14 Database backup of the entire network and database restoration for selected controllers.
 - .15 As each device is tested, a log shall be completed showing the date, technician's initials, and any corrective action taken as a result of operational failures.
 - .16 The Contractor shall display, using a third-party data packet analytical tool, that all System data transmission, including operator interface requests, are being performed using BACnet.
 - .17 Any tests that fail to demonstrate the operational compliance of the System shall be repeated, at a later date, after the issues have been resolved. The System Contractor shall be responsible for any necessary repairs or revisions to successfully complete all tests.
 - .18 Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be performed at the discretion of the Owner after acceptance and as a part of the warranty period.

3.14 CLEANING

- .1 Contractor shall clean up all debris resulting from its activities daily.
- .2 Contractor shall remove all cartons, containers, and crates under its control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.
- .3 At completion of work in any area, contractor shall clean all of its work and equipment, keeping it free from dust, dirt, and debris.
- .4 At the completion of work, equipment furnished under this Section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.15 TRAINING

- .1 The Contractor shall provide instruction on the adjustment, operation and maintenance of the System including all hardware and software provided and installed in compliance with the requirements of this specification.
 - .1 Training shall be performed by a manufacturer's representative and/or instructor or a manufacturer-trained application engineer and/or technician with a minimum of 5-years of experience in the installation, programming and operation of the System.
 - .2 All training equipment and material shall be provided by this Contractor.
 - .3 Provide a minimum of two on-site or classroom training sessions, 4 hours each, throughout contract period for personnel designated by the Owner.
 - .4 Provide two additional training sessions at 6 and 12 months following building's turnover to review Owners questions, sessional changes etc. Each session shall be 4 hours in length, on site and shall be coordinated with building Owner.
- .2 Training in the operation of the System shall be performed utilizing a BACnet network of working controllers representative of the installed network and/or the Owner's facility and shall include:
 - .1 Overview of the installed system and network architecture.
 - .2 System components.
 - .3 Graphical User Interface (GUI) operation.
 - .4 Day-to-day operations including modification of system setpoints, schedules, calendars, manual overrides, trending, log retrieval, alarm handling, etc.
 - .5 Software operation, including navigating the workstation displays, database management, troubleshooting, diagnostics, report generation, etc.
 - .6 Database design and modification including adding objects, modifying routines, optimizing operation, etc.
 - .7 General operation of the workstation hardware and peripherals.
 - .8 Access graphics, point reports, and logs
 - .9 Adjust and change system set points, time schedules, and holiday schedules
 - .10 Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
 - .11 Access data from various network and control nodes.
 - .12 Understand system drawings and the Operation and Maintenance manual
- .3 Training videos that describe the operation of the System shall be provided, and/or made accessible, to the Owner.
- .4 On-site walk-through shall cover the deployment and execution of the complete System and components including:

- .1 Sequences of Operation.
- .2 Location of all panels, enclosures, controllers, devices, sensors, etc. and equipment and panel lay-out.
- .3 Hardware preventive maintenance, calibration, troubleshooting, maintenance, and repair.
- .4 Proper use of service tools and materials.

3.16 CONTROL STABILITY AND ACCURACY PERFORMANC REQUIREMENTS

- .1 See Tables 1 through 5 on the following pages

TABLE 1: SENSOR, METER, & VALUE REQUIRED ACCURACIES

TAG	SENSOR	TYPE	SENSOR DETAILS	REQUIRED END-TO-END ACCURACY	DISPLAY RESOLUTION	REFRESH INTERVAL (MIN)	TREND INTERVAL (MIN)	REQUIRED CONTROL ACCURACY
S1	Outdoor Ambient dry-bulb temperature.	AI	10K-ohm, NTC, thermistor. Locate in weather station or ventilated enclosure in fully shaded location away from thermal mass bodies.	$\pm 0.2^{\circ}\text{C}$ ($\pm 0.36^{\circ}\text{F}$)	0.1°C (0.18°F)	1	10	$\pm 1.0^{\circ}\text{C}$ ($\pm 2.0^{\circ}\text{F}$)
S2	Outdoor Ambient wet-bulb temperature.	AI	Locate in weather station or ventilated enclosure in fully shaded location away from thermal mass bodies.	$\pm 0.3^{\circ}\text{C}$ ($\pm 0.54^{\circ}\text{F}$)	0.1°C (0.18°F)	1	10	$\pm 1.5^{\circ}\text{C}$ ($\pm 3.0^{\circ}\text{F}$)
S3	Dewpoint	AI	Chilled mirror, infrared, capacitive.	$\pm 1.5^{\circ}\text{C}$ ($\pm 3.0^{\circ}\text{F}$)	0.1°C (0.18°F)	1	10	$\pm 1.5^{\circ}\text{C}$ ($\pm 3.0^{\circ}\text{F}$)
S4	Facility, main natural gas meter	BI	Positive displacement – pressure compensated; continuous output.	$\pm 1\%$ reading, >10:1 turndown	0.05 L/s (0.1 scfm)	1	1	0.05 L/s (0.1 scfm)
S5	Natural gas flow rate	AI/BI	Positive displacement – pressure compensated; continuous output.	$\pm 2\%$ reading, >10:1 turndown	0.05 L/s (0.1 scfm)	1	1	0.05 L/s (0.1 scfm)
S6	Facility, main power meter	AI/BI	True RMS to 50 th harmonic.	$\pm 1\%$ reading	0.1 kW	1	1	0.1 kW
S7	Electric power submeter	AI/BI	True RMS to 50 th harmonic.	$\pm 1\%$ reading	0.001 kW	1	1	0.001 kW
S8	Space temperature	AI	10K-ohm, NTC, thermistor.	$\pm 0.3^{\circ}\text{C}$ ($\pm 0.54^{\circ}\text{F}$)	0.1°C (0.18°F)	1	10	$\pm 0.5^{\circ}\text{C}$ ($\pm 1.0^{\circ}\text{F}$)
S9	Carbon dioxide (CO ₂)	AI	Nondispersive infrared sensor.	± 30 ppm to $\pm 5\%$ of reading	50 ppm	1	1	40 ppm
S10	Carbon Monoxide (CO)	AI	Electrochemical sensor.	± 5 ppm	50 ppm	1	1	50 ppm
S11	Air pressure (duct)	AI		± 25 Pa (± 0.1 inwc)	125 Pa (0.5 inwc)	1	1	25 Pa (0.1 inwc)
S12	Air pressure (space)	AI		± 3 Pa (± 0.01 inwc)	3 Pa (0.01 inwc)	1	1	± 3 Pa (± 0.01 inwc)
S13	Water pressure	AI		$\pm 2\%$ of reading	7 kPa (1 psi)	1	1	3.5 kPa (0.5 psi)

TABLE 2: SENSOR, METER, & VALUE REQUIRED ACCURACIES (CONTINUED)

TAG	SENSOR	TYPE	SENSOR DETAILS	REQUIRED END-TO-END ACCURACY	DISPLAY RESOLUTION	REFRESH INTERVAL (MIN)	TREND INTERVAL (MIN)	REQUIRED CONTROL ACCURACY
S14	Water temperature	AI	10K-ohm, NTC, thermistor.	$\pm 0.5^{\circ}\text{C}$ ($\pm 1.0^{\circ}\text{F}$)	0.1°C (0.18°F)	1	1	$\pm 1.5^{\circ}\text{C}$ ($\pm 3.0^{\circ}\text{F}$)
S15	Δ Temperature	AI	10K-ohm, NTC, thermistor.	$\pm 0.2^{\circ}\text{C}$ ($\pm 0.36^{\circ}\text{F}$)	0.1°C (0.18°F)	1	1	$\pm 0.2^{\circ}\text{C}$ ($\pm 0.36^{\circ}\text{F}$)
S16	Relative Humidity (RH)	AI		$\pm 5\%$ RH	5%	1	1	$\pm 5\%$ RH
S17	Heating hot water flow	AI		$\pm 2\%$ of reading	1000 l/s (5 gpm)	1	1	± 0.032 l/s (± 0.5 gpm)
S18	Air temperature (ducted; not specified elsewhere)	AI	10K-ohm, NTC, thermistor.	$\pm 0.5^{\circ}\text{C}$ ($\pm 1.0^{\circ}\text{F}$)	0.1°C (0.18°F)	1	1	$\pm 1.5^{\circ}\text{C}$ ($\pm 3.0^{\circ}\text{F}$)
S19	Electrical (A, V, W, PF; not specified elsewhere)	AI/BI	True RMS, three-phase, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output.	$\pm 1\%$ of full-scale	0.1	1	1	0.001 kW
S20	Chiller power	AI/BI	True RMS, three-phase, integrated equipment, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output.	$\pm 1.5\%$ of reading	0.01 kW	1	1	0.001 kW
S21	Primary chilled water pump power	AI/BI	True RMS, three-phase, integrated equipment, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output.	$\pm 1.5\%$ of reading; $\pm 3\%$ VFD reading	0.01 kW	1	1	0.001 kW
S22	Chilled water condenser water pump power	AI/BI	True RMS, three-phase, integrated equipment, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output.	$\pm 1.5\%$ of reading; $\pm 3\%$ VFD reading	0.01 kW	1	1	0.001 kW

TABLE 3: SENSOR, METER, & VALUE REQUIRED ACCURACIES (CONTINUED)

TAG	SENSOR	TYPE	SENSOR DETAILS	REQUIRED END-TO-END ACCURACY	DISPLAY RESOLUTION	REFRESH INTERVAL (MIN)	TREND INTERVAL (MIN)	REQUIRED CONTROL ACCURACY
S23	Cooling tower fan power	AI/BI	True RMS, three-phase, integrated equipment, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output.	±1.5% of reading; ±3%VFD reading	0.01 kW	1	1	0.001 kW
S24	Secondary chilled water pump power	AI/BI	True RMS, three-phase, integrated equipment, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output.	±1.5% of reading; ±3%VFD reading	0.01 kW	1	1	0.001 kW
S25	Chilled water supply temperature	AI	10K-ohm, NTC, thermistor (matched with S26).	±0.5°C (±1.0°F)	0.1°C (0.18°F)	1	1	±0.5°C (±1.0°F)
S26	Chilled water return temperature	AI	10K-ohm, NTC, thermistor (matched with S25).	±0.5°C (±1.0°F)	0.1°C (0.18°F)	1	1	±0.5°C (±1.0°F)
S27	Chilled water plant flow rate	AI	Full-bore magnetic flowmeter (preferred); hot-tapped insertion flowmeter (alternate).	±0.75% of reading ±2.0% of reading	0.005 l/s (0.1 gpm)	1	1	±0.75 of reading ±2.0 of reading
S28	AHU supply fan airflow	AI	Vortex shedding sensor on fan inlet.	±5% of reading down to 0.75 m/s (150 fpm)	0.05 l/s (0.1 cfm)	1	1	±5% of reading down to 0.75 m/s (150 fpm)
S29	Airflow (measuring stations)	AI	Electronic or differential pressure.	±5% of reading	47 l/s (100 cfm)	1	1	±5% of reading
S30	Airflow (terminal)	AI	Electronic or differential pressure.	±10% of reading	47 l/s (100 cfm)	1	1	±10% of reading
S31	Airflow (pressurized spaces)	AI	Electronic or differential pressure.	±3% of reading	24 l/s (50 cfm)	1	1	±3% of reading

TABLE 4: SENSOR, METER, & VALUE REQUIRED ACCURACIES (CONTINUED)

TAG	SENSOR	TYPE	SENSOR DETAILS	REQUIRED END-TO-END ACCURACY	DISPLAY RESOLUTION	REFRESH INTERVAL (MIN)	TREND INTERVAL (MIN)	REQUIRED CONTROL ACCURACY
S32	AHU supply fan power	AI/BI	True RMS, three-phase, integrated equipment, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output.	±1.5% of reading; ±3%VFD reading	0.1 kW	1	1	0.001 kW
S33	AHU return fan power	AI/BI	True RMS, three-phase, integrated equipment, stand-alone analog or pulse output or network meter; use maximum resolution if pulse output.	±1.5% of reading; ±3%VFD reading	0.1 kW	1	1	0.001 kW
S34	AHU discharge air temperature	AI	10K-ohm, NTC, thermistor.	±0.2°C (±0.36°F)	0.1°C (0.18°F)	1	10	±0.5°C (±1.0°F)
S35	AHU mixed air temperature	AI	10K-ohm, NTC, thermistor. Use averaging sensor located in AHU mixed air section installed in a serpentine manner vertically across the duct.	±0.2°C (±0.36°F)	0.1°C (0.18°F)	1	10	±0.5°C (±1.0°F)
S36	AHU return air temperature	AI	10K-ohm, NTC, thermistor. Locate upstream of AHU return air damper.	±0.2°C (±0.36°F)	0.1°C (0.18°F)	1	10	±0.5°C (±1.0°F)
S37	AHU outdoor air damper position	AO		N/A	0.1%	1	10	0.1%
S38	AHU return air damper position	AO		N/A	0.1%	1	10	0.1%
S39	Whole-facility total water flow rate	AI	Hot-tapped insertion flowmeter.	±2% of reading >20:1 turndown	0.005 l/s (0.1 gpm)	1	1	0.005 l/s (0.1 gpm)
M1	Whole-facility peak power	AI/BI	Maximum of measured value S6 over a specified time interval.	±1%	0.1 kW	1	10	1 kW
M2	Whole-facility area-normalized electric energy use intensity	AV	Measured value S6 divided by a constant (C1) equal to building area in m ² (ft ²).	±1%	1.8 kWh/m ² (0.1 kWh/ft ²)	1	10	±1%

TABLE 5: SENSOR, METER, & VALUE REQUIRED ACCURACIES (CONTINUED)

TAG	SENSOR	TYPE	SENSOR DETAILS	REQUIRED END-TO-END ACCURACY	DISPLAY RESOLUTION	REFRESH INTERVAL (MIN)	TREND INTERVAL (MIN)	REQUIRED CONTROL ACCURACY
M3	Whole facility natural gas heat rate	AV	Measured value S4 divided by a constant (C2) equal to 0.01 therm/standard cubic feet.	±1.5%	1.8 kW/s (0.1 therms/min)	1	10	±1.5%
M4	Whole-facility area-normalized gas energy use intensity	AV	Calculated value M3 integrated over a specified interval divided by a constant (C1) equal to building area in m ² (ft ²).	±1.5%	315 kWh/m ² (0.1 therms/ft ²)	1	10	±1.5%
M5	Average daily outdoor ambient temperature	AV	Average of instantaneous measured value(s) S1.	±0.2°C (±0.36°F)	0.1°C (0.18°F)	1	10	±0.5°C (±1.0°F)
M6	Chilled water plant chilled water ΔT	AV	Calculated difference between measured values S25 – S26; sensors must be matched pair.	2% of reading or ±0.2°C (±0.36°F)	0.1°C (0.18°F)	1	1	0.1°C (0.18°F)
M7	Chilled water plant power	AV	Sum of measured values S20, S21, S22, S23, S24.	±1.5%	0.1 kW	1	10	±1 kW
M8	Chilled water loop thermal cooling output	AV	Calculated value M6 multiplied by measured value S27 multiplied by a constant (C3) equal to 1.0 kW (500 min-tons/°F-gal).	±3%	0.3 kW	1	10	±3%
M9	Chilled water plant efficiency	AV	Calculated value M7 divided by calculated value M8.	±4%	0.03 COP (0.01 kW/ton)	1	10	±4%
M10	Total AHU power	AV	Sum of calculated values S32x.	±1.5%	0.1 kW	1	10	±1.5%
M11	Total AHU flow	AV	Sum of calculated values S28x.	±5%	0.05 l/s (0.1 cfm)	1	10	±5%
M12	Total AHU specific power	AV	Calculated value M10 divided by calculated power M11.	±6%	0.0002 kW/(l/s) 0.0001 kW/cfm	1	10	±6%
M13	AHU percentage outdoor air	AV	Instantaneous difference of measured values (S35-S36)/(S1-S36).	N/A	0.1%	1	1	0.1%

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 OESC 27th Edition - CSA C22.1-18, Canadian Electrical Code, Part 1 (24th edition) Safety Standard for Electrical Installations and Ontario Amendments to that Code of Ontario Electrical Safety Code.
 - .2 CSA C22.2 No 141.
 - .3 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .4 CAN/CSA-B72-M87, Installation Code for Lightning Protection Systems
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .2 IEEE SP1122-[2000], The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- .4 CAN/ULC-S524 – Standard for the Installation of Fire Alarm Systems
- .5 CAN/ULC-S139 Standard Method of Fire Test for Evaluation of Integrity of Electrical Cables
- .6 National Building Code of Canada
- .7 All governing municipal requirements

1.2 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.3 DESIGN REQUIREMENTS

- .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.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: Provide identification nameplates and labels for control items in English.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS.
- .3 Submit for review single line electrical diagrams in glazed frames and locate on-site with Consultant.

- .4 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada, only for systems where required by Provincial or Federal Law.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 Submit copies of drawings and product data to authority having jurisdiction and inspection authorities as required.
 - .6 If changes are required, notify Consultant of these changes before they are made.
- .5 Quality Control: in accordance with Section 01 45 00 - Quality Control.
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Consultant.
 - .7 Manufacturer's Field Reports: submit to Consultant manufacturer's written report, within 7 days of review, verifying compliance of Work as described in PART 3 - FIELD QUALITY CONTROL.
- .6 Arc Flash Hazard Analysis:
 - .1 Submit an arc flash hazard analysis performed according to requirements and calculations as referenced in CAN/CSA Z462.
 - .2 Arc-Flash Hazard Analysis shall include the all 600V main distribution and 600V and 208V power panels as required to meet the requirement of CAN/CSA Z462.
 - .3 Provide equipment labels for all new pieces of equipment to suit hazard index and appropriate PPE to suit CAN/CSA Z462.

1.5 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license as per the conditions of Provincial Act respecting manpower vocational training and qualification.
- .3 Site Meetings:
 - .1 In accordance with Section 01 32 16.16 - Construction Progress Schedule
 - .2 Site Meetings: as part of Manufacturer's Field Services, schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.
 - .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29- Health and Safety Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: coordinate delivery of material to suit proposed construction schedule.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

1.7 SYSTEM STARTUP

- .1 Instruct Consultant and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .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 aspects of its care and operation.

1.8 OPERATING INSTRUCTIONS AND MAINTENANCE DATA

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Names and addresses of nearest suppliers for all items included in maintenance manuals.
- .4 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .5 Post instructions where directed.
- .6 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .7 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.9 WARRANTY

- .1 All manufacturer product and contractor labour warranties **NOT** to commence until the issuance of a certificate of substantial performance once equipment is being utilized for its intended operational purpose.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .3 Factory assembled control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls between Divisions, as indicated.
- .2 Refer to Section 26 60 00 – Powered Equipment Schedule for coordination and division of work between trades.

2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction, inspection authorities and Consultant.
- .2 Porcelain enamel signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are 90 degrees Celsius rated suitable for either copper or aluminum conductors.

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
- .2 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: Lamacoid 3mm (1/8") thick engraving sheet, BLACK face for normal/backup power equipment and RED face for life safety power equipment, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws or rivets.
 - .2 Printed adhesive backed labels in lieu of Lamacoid will NOT be considered as an acceptable alternate means of labeling.
- .3 Labels: embossed plastic labels sized to suit mounting location and tag details, with 6mm high letters unless specified otherwise. Printed adhesive backed labels will NOT be acceptable.
- .4 Wording on nameplates and labels to match equipment identifiers on plans and to be approved to suit Owner's preference if not indicated in labeling standard prior to manufacture.
- .5 Allow for minimum of twenty-five 25 letters per nameplate and label.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

- .7 Distribution switchboard(s), motor control centres, power panels, lighting panels, lighting control panels, indicate system and/or voltage characteristics and if for relay panel if fed from more than one power source indicating the source locations.
- .8 Disconnects, starters, contactors and push-button control stations: indicate equipment being controlled and voltage.
- .9 Terminal cabinets and pull boxes: indicate system and voltage.
- .10 Transformers: indicate capacity, primary and secondary voltages.
- .11 Motorized equipment and operable wall controls: indicate equipment being controlled and voltage.
- .12 All power device components including switches, receptacles and junction boxes are to be labelled as indicated below:
 - .1 Provide clear printed adhesive label tags affixed to bottom front of faceplate in BLACK.
 - .2 Provide white printed adhesive label tags affixed to wall on inside of faceplate to indicate circuit feeding location to allow faceplates to be put back in the correct location if removed in the future.

2.6 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.7 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.
- .4

	Prime	Auxiliary
up to 250 V	Yellow	Blue
up to 600 V	Yellow	Green
Telephone	Green	
Other	Green	Blue
Communication		
Systems	Yellow	
Fire Alarm	Red	
Emergency/ Life Safety	Orange	
Security		
System	Red	Yellow

2.8 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint indoor normal/backup power switchgear and distribution enclosures light gray to ASA49.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
- .2 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- .3 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .4 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.
- .5 Arrange with Division 7 for flashing and weatherproofing of holes through exterior walls.
- .6 Provide wire with flame spread rating suitable for application. (ie FT1, FT4, FT6 or MI cable as required to suit 1 HR FRR ULC S139) where indicated on the drawings.
- .7 Coordinate with all other Divisions through General Contractor for associated conduit rough-ins to avoid coordination issues and enable installation of products supplied by other Divisions to suit final approved systems shop drawings.

3.4 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.5 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centre-line of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1100 mm.to centre-line of device box
 - .2 Thermostats: 1200mm. to centerline of device box
 - .3 Wall receptacles:
 - .1 General: 400 mm to centre or as indicated.
 - .2 Systems Furniture locations: confirm rough-in location with Consultant.
 - .3 Above top of counters or counter splash backs: 200 mm.
 - .4 In mechanical/electrical rooms: 1000 mm.
 - .5 Wall receptacles mounted on building exterior: 600mm above finished grade
 - .4 Panelboards: as required by Code or as indicated.
 - .5 Communications outlets:
 - .1 General: 400 mm to centre or as indicated.
 - .2 Systems Furniture locations: confirm rough-in location with Consultant.
 - .3 Above top of counters or counter splash backs: 200 mm.
 - .6 Fire alarm manual pull-stations: mounted 1200mm to center-line as required by Code.
 - .7 Fire alarm wall mounted speakers/strobes: by Code or as indicated on drawings.
 - .8 Television communication outlets: as indicated, confirm rough-in location with Consultant.

3.6 COORDINATION STUDY, TESTING AND COMMISSIONING

- .1 Carry out general testing and commissioning in accordance with Section's 01 91 13 – General Commissioning (Cx) Requirements and 01 91 13.13 – Commissioning Plan.
- .2 Retain the services of an independent test company to prepare the co-ordination study of the entire electrical distribution system. Cost of study shall be included and paid for by the contractor. Conduct the study to provide selective trip settings of all protection devices in the electrical distribution system.
- .3 Prepare the co-ordination study on a log-log time-current characteristic sheet.
- .4 Provide the following information on the co-ordination sheets:
 - .1 Settings of Supply Authorities breaker/fuses
 - .2 HV oil-filled step-down transformer and fusing
 - .3 Main utility breaker characteristics 600V
 - .4 Feeder breaker characteristics 600V
 - .5 Thermal characteristics of transformers
 - .6 Thermal characteristics of main HV primary/ LV secondary conductors
 - .7 Indicate available 3 phase and ground fault current at the 600V and 208V switchboards and panels.
- .5 Submit the co-ordination study in the form of a sepia shop drawing.
- .6 The manufacturer performing the co-ordination study shall conduct a pre-service and in-service testing and checking of the complete distribution system and components as follows:
 - .1 Visual inspection of switchboard clearances, barriers, ventilation, grounding, etc.
 - .2 Torque checking at busbar joints, cable connections, etc.
 - .3 Mechanical and electrical operation of components and devices.

- .4 Instrumentation transformers, relays and instruments.
 - .5 Test overcurrent, voltage and ground fault relays in accordance with manufacturers' recommendations and set devices as per co-ordination study.
 - .6 Test current ratio of transformer on all tap positions, phase angle, insulation resistance and dielectric strength.
 - .7 Test continuity and resistance of ground system
 - .8 Phase rotation identification
- .7 Remedy all defects and provide services as long as is required to commission the system. The cost of providing these services is part of this contract.

3.7 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings to suit equipment coordination study and re-adjusted in the Existing Utility and Service Building as necessary.

3.8 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panel boards 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 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power generation and distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system and communications.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Consultant.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.9 PROTECTION

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts 'LIVE 120 VOLTS' or with appropriate voltage.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision.

3.10 ACCESS DOORS

- .1 Supply access doors for furred ceilings or spaces for access to electrical fitments for installation under section erecting the walls or ceilings. Supply Access doors in accordance with 08 31 00 – Access Doors – Mechanical and Electrical.
- .2 Access doors, unless otherwise specified or shown, shall be flush mounted 600 × 600 mm (24" × 24") for body entry, at least 12 gauge steel, finished prime coat only, with concealed hinges, screwdriver latches, anchor straps, rounded safety corners and shall open 180 degrees. Doors shall be of approved manufacturer with published literature.

3.11 FIREPROOFING

- .1 Provision of all firestopping required for electrical service penetration of rated walls, floors and partitions shall be the responsibility of Division 7 as indicated on the life safety drawings.

3.12 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 21 Wires and Cables (0-1000V).

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No. 18.5:22, Metallic Outlet Boxes (Trinational standard with NMX-J-023/1-ANCE-2024 and UL 514A).
 - .2 CAN/CSA-C22.2 No.65:25 Wire Connectors
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements 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 off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 – Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to NEMA to consist of:
 - .1 Connector body and stud clamp for stranded copper conductors.
 - .2 Clamp for stranded copper conductors.
 - .3 Clamp for stranded aluminum conductors.
 - .4 Stud clamp bolts.
 - .5 Bolts for copper conductors.
 - .6 Bolts for aluminum conductors.
 - .7 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, TECK cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65
 - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with NEMA.

3.3 CLEANING

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

- .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 – Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results Electrical
- .2 Section 26 05 32 – Conduits and Fittings

1.2 PRODUCT DATA

- .1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures

PART 2 PRODUCTS

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 120V Control circuits are permitted to be #14AWG Copper.
- .3 Copper conductors: size as indicated, with 600V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE RWU90 XLPE where used underground or in floor slabs, both Jacketted.
- .4 Type TWU, TWH, T90 Nylon not permitted.

2.2 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Grounding conductor: copper, size as indicated.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: 600V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking
- .6 Overall covering: thermoplastic polyvinyl chloride, meeting requirements of UL Vertical Tray Fire Test FT4 with maximum flame travel of 1220mm (48")
- .7 Fastenings:
 - .1 One hole steel or zinc straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables spaced at intervals required by OESC Code
 - .3 Threaded rods: 12 mm diameter to support suspended channels.
- .8 Connectors:

- .1 Watertight, approved for TECK cable.

2.3 VFD RATED CABLE

- .1 Conductors: shall be annealed stranded tinned copper per ASTM B3, B8 and B33, insulation rated for 90 Degrees C, Wet/Dry operating temperature, size as indicated, CSA Approved.
- .2 Insulation: Thickness shall have a minimum average wall thickness of 30mils. The insulation material shall be XLPE with a XHHW-2 listing per UL 44. Each insulated conductor shall be identified in accordance with ICEA Method 4 Colour Coding
- .3 Insulation: 1000V

2.4 ARMoured CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90
- .3 Armour: interlocking type fabricated from galvanized steel strip.
- .4 Connectors: anti short connectors.

2.5 MINERAL INSULTATED CABLES

- .1 Conductors: solid bare soft-annealed copper, size as indicated.
- .2 Insulation: compressed powdered magnesium oxide to form compact homogeneous mass throughout entire length of cable.
- .3 Overall covering: annealed seamless copper sheath, Type M1 rated 600 V, 250°C.
- .4 Overall jacket: PVC applied over the sheath and compliant to applicable Building Code classification for this project for direct buried and wet locations, as required.
- .5 Two hour fire rating.
- .6 Support and routing: steel support channel with clamps or threaded rod and tray, concealed routing coordinated on-site to suit coordination with all services.
- .7 Connectors: watertight, field installed, approved for MI cable.
- .8 Termination kits: field installed brass plates and accessories as required by approved manufacturers MI cable installation requirements.

2.6 CONTROL CABLES

- .1 Type: LVT: 2, 4, 6 or 8 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath : cotton braid

2.7 NON-METALLIC SHEATHED CABLE

- .1 Shall not be used on this project.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform insulation tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 In surface and lighting fixture raceways in accordance with Section 26 50 00, 26 05 33

3.4 INSTALLATION OF TECK90 CABLE (0 - 1000 V)

- .1 Group cables wherever possible on channels.
- .2 Not to be installed in lengths greater than 6' unless with the written permission of the Consultant.

3.5 INSTALLATION OF VFD RATED CABLE

- .1 Install VFD Rated cable on line and load sides of all VFDs and reactors.

3.6 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.
- .2 Type AC90 is only to be used in extremely short lengths (of 10' or less) and are only to be used for fixture drops from conduit boxes.
- .3 AC90 is never to be used for home runs for lighting or power devices and will be ordered to be removed if so installed.
- .4 Use AC90 for this purpose only and only where specifically called out on the drawings.

3.7 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit from cable tray to devices
- .2 Install control cables in cable tray
- .3 Ground control cable shield.

3.8 INSTALLATION OF NON-METALLIC SHEATHED CABLE

- .1 Never use Non Metallic Sheathed Cable.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 01 - Common Work Results - Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association, (CSA International)

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 Copper conductor: bare, soft annealed, stranded, untinned copper ground conductor for system and equipment ground, size as indicated, minimum as dictated by code.
- .2 Rod electrodes: copper clad steel 19 mm dia by 3 m long, minimum.
- .3 Grounding conductors: bare stranded copper, untinned, soft annealed, minimum 3/0 AWG copper conductor to each ground electrode.
- .4 Insulated grounding conductors: green, type TWH or TWU, where indicated.
- .5 Ground bus: copper, size as indicated, complete with 600V insulated supports, fastenings, connectors.
- .6 Supply 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
 - .7 Compression ground connectors.
- .7 Compression grounding connectors used to make permanent grounding connections must be rated for direct burial, embedding in concrete and for above grade applications
 - .1 Compression connectors shall be made of pure, wrought copper, meeting ASTM B187, essentially the same as the conductors being connected.
 - .2 Cast connectors shall be made of copper base alloy according to ASTM B30 (latest revision).
 - .3 All connectors must be of heavy duty design and must be equivalent in current carrying capacity to the maximum size copper conductors being joined while maintaining high mechanical strength and electrical integrity.
 - .4 Terminals and splices may accommodate only one conductor size. All other connectors must be range taking.
 - .5 All connectors must be designed to provide high integrity connections.
 - .6 Connectors must be pre-filled or filled at time of connection with a corrosion inhibiting compound which is compatible with the conductors being joined.

PART 3 EXECUTION

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous system and equipment grounding systems including, electrodes, conductors, connectors, accessories, as indicated.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at [both] [one] ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Install separate ground conductor, green TW75 insulation to outdoor lighting standards.
- .10 Connect building structural steel and metal siding to ground by welding copper to steel.
- .11 Bond single conductor, metallic armoured cables to cabinet at supply end, provide non-metallic entry plate at load end.
- .12 Ground secondary service pedestals.
- .13 Ensure uniformity of grounding practices throughout installation.

3.2 ELECTRODES

- .1 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.
- .2 Install rod electrodes and make grounding connections.
- .3 Bond separate, multiple electrodes together.
- .4 Use size 3/0 AWG copper conductors for connections to electrodes.

3.3 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to the neutrals of the electrical distribution system, as indicated.

3.4 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, cable trays, frames of

motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.5 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall in Incoming Electrical and server room, scope of work as indicated on the drawings.
- .2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0AWG.

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 - Common Work Results - Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of 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

PART 1 GENERAL

1.1 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41mm (1 5/8"), 2.5 mm thick, surface mounted, suspended by 1/2" Threaded Rod or embedded in concrete as required outside of production areas/laboratories; within production and laboratory areas include sealed type with channel inserts as required.
- .2 Galvanized Steel used indoors outside of production areas/laboratories.
- .3 Stainless Steel where required outdoors.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .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 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 12 mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 12 mm dia threaded rod

hangers where direct fastening to building construction is impractical.

- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 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.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .13 Where cutting of galvanized strut is required, touch up the cut ends with galvanizing paint.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

PART 2 PRODUCTS

2.1 SPLITTERS

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: main and branch lugs or connection blocks to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat turned edge covers.

2.3 CABINETS

- .1 Construction: welded sheet steel, hinged door, handle, latch and catch
- .2 Type E Empty: flush overlapping sides mounting as required.
- .3 Type T Terminal: flush overlapping sides mounting as required containing 19 mm G1S plywood backboard.

PART 3 EXECUTION

3.1 SPLITTER INSTALLATION

- .1 Mount plumb, true and square to 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 2 m above finished floor except where indicated otherwise.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Coordinate all main junction and pull boxes to suit conduit runs and wire sizes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00- Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name voltage and phase.

END OF SECTION

PART 1 GENERAL

1.1 LOCATION OF CONDUITS

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12, Ontario Electrical Safety Code, Part 1

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

PART 2 PRODUCTS

2.1 CONDUIT

- .1 Rigid PVC Conduit (RPVC)
- .2 Rigid Galvanized Steel Conduit (RGSC)
- .3 Electrical Metallic Tubing (EMT)
- .4 Electrical Non-Metallic Tubing (ENMT)
- .5 Flexible Metal Conduit and Liquidtight Flexible Metal Conduit

2.2 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for all 347 V line voltage switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.
- .7 Standard of Acceptance: Iberville, Hubbell or equal Canadian manufactured and CSA certified product.

2.3 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished plaster and tile walls.
- .6 Standard of Acceptance: Iberville, Hubbell or equal Canadian manufactured and CSA certified product.

2.4 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.5 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.6 FLOOR BOXES

- .1 Refer to Electrical Schedules for Types of Floorbox complete with manufacturer and insert requirements.
- .2 Standard of Acceptance: As noted in Electrical Equipment Schedule or equal/alternate product approved by the Consultant.

2.7 CONDUIT BOXES

- .1 Cast FS aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.
- .2 Standard of Acceptance: Iberville, Hubbell or equal Canadian manufactured and CSA certified product.

2.8 PULSTRINGS

- .1 Polypropylene nylon, 6mm (1/4") for conduits to 1"
- .2 Braided Nylon, 12mm (1/2") for conduits to 4".

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 35mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, 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 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.
- .7 Conceal conduit in walls, partitions and ceilings. Provide access panels in areas where access is required to junction boxes.
- .8 Install EMT surface mounted in mechanical, electrical telecommunications rooms and the overhead link.
- .9 Install Rigid Galvanized Conduit where subject to mechanical injury
- .10 Provide Expansion Fittings where conduits pass over expansion joints.
- .11 Seal conduits passing through an outside wall with duct seal at the closest outlet box on the outside wall. If the distance from the nearest outlet box to point where conduit passes through wall exceeds 1524mm (5'), install an outlet box just inside the wall and seal conduit at that location. Install duct seal after all wiring has been completed.
- .12 Install rigid galvanized steel conduit 762mm (30") below finished grade and extend 75mm (3") beyond the outside wall surface where conduit runs pass through the foundation walls. Couple to rigid PVC conduit for continuation of underground electrical or telecommunication service to outdoor locations.
- .13 Do not use perforated steel supports (all round)
- .14 Make exposed conduit parallel to the building lines to present a neat and tidy appearance. Make offsets at similar locations and parallel in areas where two or more runs are together. Failure to coordinate conduit runs with each other will result in the Consultant rejecting the installation.
- .15 Use liquidtight flexible conduit for final connections to motors and loads subject to vibration.
- .16 Run conduit to avoid proximity to water or heating pipes. Do not run within 75mm of pipes, and where unavoidable, contact Consultant for direction. Proceed with direction from Consultant.

- .17 Lengths of Flexible Metallic Conduit are not permitted to be longer than 6' unless prior permission has been obtained from the Consultant, under documented writing.
 - .18 Type AC90 has very limited use, refer to Section 26 05 21.
- END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 21 – Wires and Cables
- .2 Section 26 05 29 – Hangars and Supports
- .3 Section 26 05 32 – Outlet Boxes, Conduits and Fittings

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45-M1981(R2003), Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
- .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.

PART 2 PRODUCTS

2.1 CABLES AND REELS

- .1 Provide cables on reels or coils.
 - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.

- .2 Each coil or reel of cable to contain only one continuous cable without splices.
- .3 Identify cables for exclusively dc applications.
- .4 Reel and mark shielded cables rated 2,001 volts and above.

2.2 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 PVC conduit: to CSA C22.2 No. 211.2.
- .5 Flexible metal conduit: to CSA C22.2 No. 56, steel, liquid-tight flexible metal.
- .6 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.

2.3 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits NPS 2" (50 mm) and smaller.
 - .1 Two hole steel straps for conduits larger than NPS 2" 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at maximum length permitted for smallest conduit on rack by code.
- .4 Threaded rods, 12 mm diameter, to support suspended channels.

2.4 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 180 degrees bends for NPS 1" (25 mm) and larger conduits.
- .3 EMT Connectors:
 - .1 Watertight connectors and couplings for EMT where routed below sprinkler heads, installed in location exposed to the weather or at exposed penetrations into the top of electrical equipment.
 - .2 Set screw type steel connectors are acceptable where EMT conduit is routed in walls, above ceiling and/or sprinkler heads where there is no possibility of direct water stream or ingress of moisture.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.

- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .3 Use epoxy coated conduit underground and in corrosive areas.
- .4 Use electrical metallic tubing (EMT) except in cast concrete, above 2.4 m not subject to mechanical injury.
- .5 Use rigid PVC conduit underground and in corrosive areas.
- .6 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without prewired outlet box, connection to surface or recessed fluorescent fixtures, work in movable metal partitions.
- .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .8 Use explosion proof flexible connection for connection to explosion proof motors.
- .9 Install conduit sealing fittings in hazardous areas.
 - .1 Fill with compound.
- .10 Minimum conduit size for lighting and power circuits: NPS 1/2", (12 mm.)
- .11 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .12 Mechanically bend steel conduit over 35 mm diameter.
- .13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .14 No Running of Threads Permitted
- .15 Install fish cord in empty conduits.
- .16 Run 2-NPS 1 (25 mm) spare conduits up to ceiling space and 2-NPS 1 (25 mm) spare conduits down to ceiling space from each flush panel.
 - .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .17 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.

- .18 Dry conduits out before installing wire.
- .19 Use flexible metal conduit exposed only where specifically indicated on drawings or with approval of Consultant, or for final fixture tails, not longer than 10' and as above in .6.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels, where applicable
- .5 Do not pass conduits through structural members except as indicated or with permission of Consultant.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
- .2 Install in centre one third of slab.
- .3 Protect conduits from damage where they stub out of concrete.
- .4 Install sleeves where conduits pass through slab or wall.
- .5 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .6 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .7 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .8 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits NPS 1 (25 mm) and larger below slab and encase in 75 mm concrete envelope.
 - .1 Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results - Electrical.
- .2 Section 26 05 11 – Direct Buried Ductbanks
- .3 Section 26 05 21 – Wires and Cables (0-1000V)

1.2 REFERENCES

- .1 Canadian Standards Association, (CSA International)
- .2 Insulated Cable Engineers Association, Inc. (ICEA)

1.3 SUBMITTALS

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

PART 2 PRODUCTS

2.1 MARKERS

- .1 Concrete type cable markers: 600 x 600 x 100 mm with words: conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

PART 3 EXECUTION

3.1 CABLES IN UNDERGROUND DUCTS

- .1 Underground cable splices not acceptable, unless prior permission has been obtained in writing from the consultant, or if shown on the drawings specifically.
- .2 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.
- .3 Maintain 75 mm (3") minimum separation between cables of different circuits. Maintain 300 mm (12") horizontal separation between low and high voltage cables. When low voltage cables cross high voltage cables maintain 300 mm (12") vertical separation with low voltage cables in upper position. At crossover, maintain 75 mm (3") minimum vertical separation between low voltage cables and 150 mm (6") between high voltage cables. Maintain 300 mm (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.

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 multiconductor 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 at standard intervals along duct runs to suit length of run and changes in direction.
- .2 Mark underground splices.
- .3 Where markers are removed to permit installation of additional cables, reinstall existing markers.
- .4 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 - Common Work Results - Electrical.
- .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(MΩ)
- .5 Acceptance tests for LV cables (less than 600VAC):
 - .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 Provide Consultant with list of test results showing location at which each test was made, circuit tested and result of each test.
- .7 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 91 13.13 – Commissioning Plan.
- .2 Section 26 09 43.1- Lighting Control System – System Design and Commissioning Schedules
- .3 Section 26 50 00 – Lighting
- .4 Section 26 Electrical Sections, including wiring devices, apply to the work of this Section.

1.2 SUMMARY

- .1 The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight where noted), and manual lighting control.
- .2 The system shall be capable of turning lighting loads on/off as well as program dimming lights as long as the lighting load noted is capable of being dimmed (eg. 0-10V dimming terminals).
- .3 All system devices shall be included with network connections and control programming to suit method of operation as indicated on the drawings and access to interface.
- .4 All components required for complete operation whether specifically indicated on the drawings with a symbol or not are a requirement of this contract by this contractor and associated approved lighting control system shop drawings; all specific control location details and placement of sensors, daylight harvesting devices and wiring, etc. to be resolved during construction based on manufacturer recommended placement and operation to ensure system operates as specified.
- .5 The system shall not require any centrally hardwired switching equipment and shall be capable of communication from fixture to fixture with all conduit, wiring, devices, etc. as necessary to suit final approved manufacturer shop drawings.
- .6 The system shall be capable of operation and method of control as indicated on the drawings and commissioned with devices and to operate in accordance with Section 26 09 43.1B by a 3rd party for OBC SB-10 compliance based on ASHRAE 90.1-2017 compliance route and mandatory control requirements with light levels, etc. to be finalized with Owner/Consultant at time of final system commissioning.

1.3 SHOP DRAWINGS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.
 - .2 Shop Drawings:
 - .1 Composite wiring and/or schematic diagram of each control circuit as proposed to be installed including all other diagrams as needed for special operation or interaction with all other building systems (standard diagrams will not be accepted).
 - .2 Scale drawing for each area showing exact location of each device and associated interconnectivity.
 - .3 Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up
 - .4 All other operational descriptions to suit programming in each area.

- .3 Product Data: Catalog sheets, specifications and installation instructions.
- .4 Sequence of operation to describe how each component operates and how any building wide functionality is achieved to minimum local OBC SB-10 requirements based on ASHRAE 90.1-2017.
- .5 Include data for each device which:
 - .1 Indicates where sensor is proposed to be installed.
 - .2 Prove that the sensor is suitable for the proposed application.

1.4 COORDINATION

- .1 Coordinate the placement of lighting control panels
- .2 Coordinate the placement of sensors, wall-stations and other user input devices
- .3 Coordinate the placement of daylight sensors to achieve optimal daylight dimming
- .4 Prewire meeting: conducted on-site or during design meeting with lighting control system manufacturers or designated representative prior to commencing work as part of the manufacturer's standard practice and startup services. Manufacturer to review with the installer:
 - .1 Installation of lighting control panels and locations
 - .2 Lighting control network wiring
 - .3 Network IT requirements
 - .4 Low voltage wiring requirements
 - .5 Lighting control integration requirements
 - .6 Lighting control system integration network wiring and connectivity
 - .7 Installer responsibilities
 - .8 Startup and training schedule and actions
- .5 Coordinate with all other Sections as necessary for a complete system installation as noted on the drawings.
- .6 The installing contractor shall be responsible for a complete and functional system in accordance with all regulations to suit approval by the AHJ.

1.5 WARRANTY

- .1 Provide a five-year complete manufacturer's warranty on all products to be free of manufacturers' defects.

1.6 QUALITY ASSURANCE

- .1 In high humidity or cold environments such as the rink areas; the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.
- .2 Manufacturer: manufacturer shall have at least 10 years of experience in the manufacture of lighting control systems. Manufacturers that do not have at least 10 years of experience shall not be acceptable.
- .3 System components:
 - .1 All applicable products must be CSA/cUL listed or other acceptable national testing organization.
 - .2 Listed by FCC specifically for the required wireless communication protocols. Provide evidence of compliance upon request.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
- .3 Packaging Waste Management: remove for reuse and return if applicable of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.
- .4 Do not install equipment until following conditions can be maintained in spaces to receive equipment:
 - .1 Ambient temperature: 0° to 40° C (32° to 104° F).
 - .2 Relative humidity: Maximum 90 percent, non-condensing.

1.8 CLOSEOUT SUBMITTALS

- .1 Provide within 90 days after the date of system acceptance, record drawings of the actual system specific installation be provided to the Owner and shall include as minimum: lighting equipment location, luminaire identifier, control type and location and circuiting of each piece of lighting equipment.
- .2 Provide Operation and Maintenance Manuals for all lighting controls within 90 days after the date of system acceptance and shall include at a minimum, the following:
 - .1 Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.
 - .2 Routine maintenance procedures for all devices including a recommended maintenance program and a schedule for inspecting and recalibrating lighting controls.
 - .3 Complete narrative of how each lighting control system is intended to operate including all programmed settings at the completion of commissioning.

PART 2 PRODUCTS

2.1 MANUFACTURER APPROVALS

- .1 Acceptable Base Bid Manufacturer(s); all subject to compliance and approval with the same operational intent as indicated on the drawings for complete designed and installed performance based lighting control system in accordance with Section 26 09 43.1B commissioning schedule and device placement, quantities, etc. to be resolved during detailed shop drawing review and OBC code requirements:
 - .1 Cooper Lighting Solutions by Waterman Sales as per the drawings
- .2 Approved Products are to be a product of the same manufacturer as Section 26 50 00 lighting being proposed to ensure compatibility of control system with fixtures and future maintenance:
 - .1 All manufacturers even those listed as acceptable base bid manufacturers above are subject to compliance and approval with the same operational intent as indicated on the drawings for complete designed and installed performance based lighting control system in accordance with Section 26 09 43.1B commissioning schedule and device placement, quantities, etc. to be resolved during detailed shop drawing review and requirements for ASHRAE 90.1-2017 c/w OBC-SB-10 amendments compliant lighting control system.
 - .2 All proposed system solutions or alternates must be submitted in writing for approval by the design professional no later than fourteen (14) calendar days prior to the tender closing

date and shall include a job specific submission in accordance with Section 1.3 above and 2.2 below indicating at minimum:

- .1 Proposed system layout and network topology for building layout, device cut-sheets and dimming/control methodology, ULC approved emergency lighting switching, dimming load types, lighting control network topology and routing,.
- .2 Confirm the ability to meet the base system performance design requirements as indicated in Section 26 09 43.1 with any and all deviations from the base system design specifically noted or highlighted for review and approval by Consultant; the Consultant reserves the right to discard submissions not submitted to the standard noted above; products must be made available to all bidders and confirmed with bidders for tender pricing purposes associated with proposed system installation.
- .3 For proposed solutions by this Section not using the base-bid Section 26 50 00 luminaires; submission should take into account approval of associated alternate fixtures in accordance with Section 26 50 002.5.3 for use with proposed control system to enable acceptance by Consultant in writing.
 - .1 Acceptable Alternative Solution/Manufacturer:
 - .1 For wireless lighting control system alternatives meeting the intent of the design requirements on the contract documents including wireless versions from approved manufacturers; provide submittals in accordance with Section 01 34 00 procedures.
 - .2 Contractor shall not include these alternatives in the base bid price and can provide this system and include in Section 00 41 13c – Tender Form Appendix C – Unsolicited Alternate Prices with narrative and associated cost “deduct” if the wireless alternative to the lighting control system is accepted at time of tender.
 - .3 By using unsolicited alternate substitutions, the contractor accepts responsibility and associated costs for all required design modifications to circuitry, devices, and wiring by Consultant if necessary to implement system change. The contractor shall provide complete engineered shop drawings (including power and control wiring as necessary) with deviations from the original design highlighted in an alternate color to the engineer for review and approval prior to rough-in.

2.2 SYSTEM REQUIREMENTS

- .1 The lighting control system is based upon three main concepts;
 - .1 intelligent lighting control devices
 - .2 standalone lighting control zones
 - .3 network communications via backbone and wireless transmitter/receivers for remote or time based operation.
- .2 Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations.
- .3 Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher-level network backbone.
- .4 Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.
- .5 All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself unless noted otherwise (i.e. not in a remotely located devices such as panels) to

facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.

- .6 System shall have a software management program that enables remote system control, status monitoring, and creation of lighting control profiles accessible over the Owners network.
- .7 System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized as noted on the plans and commissioned as indicated in Section 26 09 43.1- Networked Lighting Control System Programming & Commissioning Schedules consistent with ASHRAE 90.1 mandatory control requirements for each type of space. The following are general configurations for typical control modes:
 - .1 Auto-On / Auto-Off (via occupancy sensors)
 - .1 Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - .2 Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - .3 Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.
 - .2 Auto-On to 50% / Auto-Off (via occupancy sensors)
 - .1 Zones with occupancy sensors automatically turn lights on to 50% when occupant is detected.
 - .2 Zones with occupancy and/or photocell sensors turn lights off when vacancy is detected and automatically dim daylight harvest zones if sufficient daylight is detected.
 - .3 Pressing the switch will turn light zone off and each switch will have up/down dimmer for control to suit fixture zoning. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.
 - .3 Manual-On / Auto-Off (also called Semi-Automatic)
 - .1 Pushing a switch will turn lights on.
 - .2 Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - .4 Manual-On to Auto-On/Auto-Off
 - .1 Pushing a switch will turn lights on.
 - .2 After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.
 - .3 Sequence can be reset via scheduled (ex. daily each morning) events
 - .5 Auto-to-Override On
 - .1 Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - .2 Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
 - .3 Sequence can be reset via scheduled (ex. daily each morning) events
 - .6 Manual-to-Override On
 - .1 Pushing a switch will turn lights on.
 - .2 Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
 - .3 Sequence can be reset via scheduled (ex. daily each morning) events
 - .7 Auto On / Predictive Off
 - .1 Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - .2 Zones with occupancy and/or photocell sensors turn lights off when vacancy or

- .3 sufficient daylight is detected.
If switch is pressed, lights turn off and a short "exit timer" begins. After timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install the work of this Section in accordance with the approved shop drawings for locations of devices, etc. and utilize manufacturer's printed instructions unless otherwise indicated.
- .2 All network-based lighting control network cabling/wiring is to be installed and routed in accordance with manufacturer's recommendations for a clean installation, such as the below based on the base bid control system:
 - .1 Cabling for network wiring to meet manufacturers recommendations and supplied/installed in accordance with manufacturers standards including end terminations and testing.
 - .2 All cabling to be routed with use of cable hangers and EMT conduits through fire rated walls, etc.
 - .3 All cabling passing power cables to do so at 90-degree angle and never run close to high voltage sources of power with at least 12" clearance left from sources of line voltage.
 - .4 Do not damage the jacket or overstress the conductors.
 - .5 Route network cabling in neat runs away from power conductors.
- .3 Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
 - .1 Adjust time delay so that controlled area remains lighted for 5 minutes after occupant leaves office or enclosed area.
 - .2 Adjust time delays in corridors and higher-use areas to prevent lights from cycling on and off to save electronic equipment life.
- .4 Provide written or computer-generated documentation on the commissioning of the system with a room by room description including:
 - .1 Sensor parameters, time delays, sensitivities, and day-lighting set points.
 - .2 Sequence of operation to suit method of operation indicated on the plans and as coordinated with the Consultant.
 - .3 Re-commissioning – After 30 days from occupancy re-calibrate all sensor time delays and sensitivities to meet the project requirements. Provide a detailed report to the Consultant / Owner of re-commissioning activity.

3.2 FACTORY COMMISSIONING AND FUNCTIONAL TESTING

- .1 Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system certifying installation meets or exceeds documented performance criteria.
- .2 The project commissioning by the manufacturer's representative will be performed to suit Consultant supplied programming schedule indicating the proposed method of operation for each space using networked controls during construction at time of shop drawing approval to ensure system compliance with AHJ mandatory requirements.
- .3 The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the system startup and adjustment date.

- .4 Manufacturer shall provide a factory authorized technician to confirm proper installation and operation of the lighting control panels, switches, and occupancy sensors.
- .5 The technician shall provide training on the lighting control features of the system and shall verify that the devices are communicating with the head-end system.
- .6 Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the Owner's personnel on the adjustment and maintenance of the system to the satisfaction of the Consultant.
- .7 All system commissioning included associated site visits for original set-up and fine tuning after 90 days after system turn-over is to be included in the project delivery at no additional cost to the Owner regardless of manufacturer additional charges due to miscoordination by Section 26 contractor for the services if not negotiated by this section at time of tender.

3.3 CLEANING

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

3.4 SPARE PARTS

- .1 Provide 5% spare quantity of all power packs, control modules, etc.

END OF SECTION

PART 1 GENERAL

1.1 LIGHTING CONTROL – OPERATIONAL SYSTEM DESIGN REQUIREMENTS & COMMISSIONING/PROGRAMMING SCHEDULES

- .1 Refer to Section 26 09 43.1B - LIGHTING CONTROL – OPERATIONAL SYSTEM DESIGN REQUIREMENTS & COMMISSIONING/PROGRAMMING SCHEDULES which lists all lighting control device and programming requirements for design of system to operate as indicated on the drawings to suit approved controls vendors as noted in Section 26 09 43; all system operation to suit design intent and commissioning of system to be supplied by this Section including as many field visits, etc.

1.2 USE OF THE SCHEDULE

- .1 Read the schedule, together with the drawings and other Sections of this Specification, for scope of work related to all lighting controls and programming requirements.

END OF SECTION

General Instructions

1. All special programming and sequence of operations scope of work for lighting control and scenes in large open spaces and specialty control locations have been indicated on the drawings to inform the system commissioning scope of work and have been noted as such below.
2. In all typical spaces such as public thoroughfares, corridors, etc. and in accessible areas where indicated; commissioning contractor to utilize light meter to validate light levels meet design light level requirements and metrics as noted below and on the drawings; confirm the preferred maximum light level with the Owner; modify dim trim limits with capable controls as necessary in areas indicated with the "Auto/Program Dim" selected to ensure all Auto ON lights turn on to the pre-set dimming level to suit the Owner's operational requirements of the space and to include the ability (where indicated) to manually adjust within the pre-configured dimming range.
3. Coordinate and pay all costs for 3rd party verification and ASHRAE 90.1 compliance report as indicated in Specification Section 26 09 43, item 3.2.2.

1. LIGHTING CONTROL SYSTEM OPERATION AND PROGRAMMING SCHEDULE

1. Instructions:

1. Confirm controls operate as per manufacturer's specifications; check and adjust occupancy sensor controls to suit usage of the space and to prevent un-necessary fixture cycling; check daylight switching/dimming systems and commission to suit circuiting as noted on the plans and comments in this schedule.
2. Confirm no unusual ballast/driver noise or vibration.

Room No.	Room Name	Controls (Note 1)										Operational/Programming Requirements (Note's 2 & 3)	
		Manual Switching	Manual Dimming	Auto/Program Dim	Daylight On/Off	Daylight Dimming	Occupancy	Program Scenes	Partition Sensor	Scheduled	Always On / Night Light		Emergency
Exterior													
	Wall Packs			X	X	X							Integral Photocell dimming to be turned off when sufficient daylight is present.
	Pole Lights			X	X	X							Integral Photocell dimming to be turned off when sufficient daylight is present.
Office Area													
100	Vestibule			X			X				XX		Auto ON / Auto dim to 50% after 15 minutes of vacancy.
101	Office #1	X	X				X						Manual ON / Auto OFF c/w manual ON/OFF/DIM at wall.
102	Office #2	X	X				X						Manual ON / Auto OFF c/w manual ON/OFF/DIM at wall.
103	Office #3	X	X				X						Manual ON / Auto OFF c/w manual ON/OFF/DIM at wall.
104	Office #4	X	X				X						Manual ON / Auto OFF c/w manual ON/OFF/DIM at wall.
105	Office #5	X	X				X						Manual ON / Auto OFF c/w manual ON/OFF/DIM at wall.

[illegible]

Room No.	Room Name	Controls (Note 1)									Operational/Programming Requirements (Note's 2 & 3)	
		Manual Switching	Manual Dimming	Auto/Program Dim	Daylight On/Off	Daylight Dimming	Occupancy	Program Scenes	Partition Sensor	Scheduled	Always On / Night Light	Emergency
127	Service Garage	X	X				X					X
128	Hallway	X					X					X
129	WC/Shower	X					X					X
130	Female Change Room	X	X				X					X
131	Hallway	X					X					X
132	Laundry	X					X					
133	WC/Shower	X					X					X
134	WC/Shower	X					X					X
135	Male Change Room	X	X				X					X
136	Lunchroom	X	X				X					X
137	Workstation	X	X				X					X
138	WC	X					X					X
139	Mechanic Office	X	X				X					
140	Hallway	X					X					X
141	Mechanical Services	X										X
142	Wash Bay	X	X				X					X
143	Repair Area	X	X				X					X
201	Catwalk	X					X					X
202	Open Storage	X					X					

2. ILLUMINATION LEVEL COMMISSIONING

A. NORMAL LIGHTING

1. Instructions:

- Review all spaces against general lighting levels provided for space types below, adjust dimming setting of fixtures to meet the AVG maintained illumination levels noted for the spaces type to reduce fixture glare and save energy where fixture spacing creates an over-lit environment. Take measurements when no daylight contribution and make modifications to daylight harvesting to suit worst case and best case natural lighting scenarios.
2. Measurements to be taken as follows:
 1. Offices: desktop at typical work space. Measure after furniture installed or based on proposed furniture height.
 2. Corridors & Egress Routes: floor minimum value centerline of corridor and egress routes. Measure before occupancy.

Room.	Space Type/Scene Description	Min/Max Required Illumination (fc)	Measured Illumination		Instructions
			fc	Location	
General	Public & General Corridors	5 fc Min, 15 fc AVG		Floor Level at Middle of hall between fixtures	Commission corridor lighting zones to suit required light level of 20 fc AVG maintained down centerline of hallway, adjust dimming setting in lighting control software for corridor lighting controllers to reduce glare and save energy.
General	Office(s)	Min 40 fc at desk		Centre of space at desk, between and not directly beneath a fixture	Commission fixtures/control zones to suit daylight contribution during the daytime for even illumination in space based on minimum light level provided
General	Multi-Purpose Rooms	Max 30 fc at desk		Floor Level	Set maximum output of fixtures for manual user control to 80% and confirm light level on-site with Consultant and Owner.
General	Stairwells	1 fc Min, 5 fc AVG		Stair Tread Surface	Commission stairwell fixtures to operate when occupied to dim to provide at minimum the AVG light level for max energy saving, dim down to 50% output when space is unoccupied.
General	Main Lobby	20 fc		Centre of each space at floor level, between and not directly beneath a fixture	Commission lighting in groups and dim settings to suit proposed 20 fc AVG with graphical user interface control for programming changes and manual dimming control, confirm light levels acceptable to Owner for scene configurations to suit different uses of the space and need for A/V control, etc.

Performed By: _____ **Signature:** _____
Representing: _____ **Date:** _____
 (Div. 26 Contractor)
Comments: _____

PART 1 GENERAL

1.1 SECTION CLUDES

- .1 Materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results - Electrical.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2 No.47, Air-Cooled Transformers (Dry Type).
 - .2 CSA C9, Dry-Type Transformers.
 - .3 CAN/CSA-C802.2, Minimum Efficiency Values for Dry-Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA)
- .3 Ontario Regulation 404/12 – Energy Efficiency

1.4 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

PART 2 PRODUCTS

2.1 TRANSFORMERS

- .1 Use transformers of one manufacturer throughout project and in accordance with CAN/CSA-C22.2 No.47.
- .2 Design.
 - .1 Type: K-13 rated or as noted on BOM
 - .2 3 phase, kVA as noted, 600 V input, output as noted, 60 Hz.
 - .3 Voltage taps: standard.
 - .4 Insulation: Class 220, 150 degrees C temperature rise.
 - .5 Basic Impulse Level (BIL): 10kV.
 - .6 Average sound level: standard
 - .7 Impedance at 17 degrees C: standard
 - .8 Efficiency: O. Reg 404/12
 - .9 Enclosure: NEMA 1 c/w drip shield to meet NEMA 2 or as indicated in BOM.
 - .10 Mounting: Floor mounted, provide Unistrut structure for stacked transformers approved by structural engineer.
 - .11 Finish: in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .3 Scott T connected 2 coil type transformers will **NOT** be accepted.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Mount dry type transformers as indicated on the drawings, confirm mounting method that is flexible to suit field installation by Div. 26 as long as space is utilized effectively and confirm final layout for locations of transformers and mounting with Consultant prior to rough-in.
- .2 Ensure adequate clearance around transformer for ventilation and in accordance with OESC requirements.
- .3 Install transformers in level upright position.
- .4 Remove shipping supports only after transformer is installed and just before putting into service.
- .5 Loosen isolation pad bolts until no compression is visible.
- .6 Make primary and secondary connections in accordance with wiring diagram.
- .7 Energize transformers after installation is complete.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 28 16.02 – Moulded Case Circuit Breakers
- .2 Section 26 24 02 – Distribution Sections and Panels – for power monitoring tie in to main power monitoring system.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.29, Panelboards and enclosed Panelboards.
 - .2 CSA C22.2 No.5.1, Moulded Case Circuit Breakers

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

PART 2 PRODUCTS

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment as applicable.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 250 & 600 V panelboards: bus and breakers rated as indicated on the single line diagram (rating applies to both bus and breakers).
- .3 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.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Two keys for each panelboard and key panelboards alike.
- .6 Copper bus with neutral of same ampere rating as mains. Copper neutral bus, and copper ground bus.
- .7 Mains: suitable for bolt-on breakers.
- .8 Trim with concealed front bolts and hinges.
- .9 Trim and door finish: baked grey enamel.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panel boards except as indicated otherwise.
- .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 15 to 30 A breakers installed as indicated.

2.3 POWER MONITORING

- .1 Provide complete branch circuit power monitoring provisions in panel boards for tie in to facility power monitoring system by Div. 26 to enable itemized tracking of load types, etc. on panels as indicated on the drawings.
- .2 Power monitor is to be by the same manufacturer as electrical distribution equipment and power monitoring system as indicated in Section 26 24 02 supplied by this section to be confirmed at time of shop drawing review and approval.

2.4 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical – Appendix A.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.5 STANDARD OF ACCEPTANCE

- .1 All equipment supplied by this section shall include the same make/manufacturer of circuit breakers as major equipment supplied by Section 26 23 00 for a complete distribution system by one manufacturer.
- .2 The following manufacturers are approved and to be provided as necessary to match manufacturer's circuit breakers utilized by Section 26 23 00 equipment to suit the base bid and all approved alternate products:
 - .1 Schneider (Square D), Eaton (Cutler-Hammer), Siemens.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards sealed with grey paint; all in accordance with Section 06 10 00 - Rough Carpentry. Where practical, group panelboards on common backboard.

- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results - Electrical or as indicated.
- .4 Connect loads to circuits, connect bonding and ground conductors.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Install circuit breakers as indicated.
- .7 Provide breaker space fillers as required.

3.2 ADJUSTING AND CLEANING

- .1 Clean all panelboards on completion of work. Adjust panel trims to properly fit. Adjust all breaker trips.

3.3 SPARES

- .1 Provide spares as indicated on panel schedules.
- END OF SECTION

PART 1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit fuse time-current characteristics for each fuse type and size. Time-current characteristics to include: average melting time-current, I^2t (for fuse coordination), and peak let-through current.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in equipment.
- .3 Store fuses in original containers in moisture-free storage cabinet.

1.3 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Three spare fuses of each type and size.

PART 2 PRODUCTS

2.1 FUSES - GENERAL

- .1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer.

2.2 FUSE TYPES

- .1 Class J fuses.
 - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .2 Type J2, fast acting.
- .2 Class R -R fuses.
 - .1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.
 - .2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
- .3 Class C fuses.

2.3 FUSE STORAGE CABINET

- .1 Fuse storage cabinet, manufactured from 2.0mm thick aluminum 750 mm high, 600mm wide, 300mm deep, hinged, lockable front access door finished in accordance with Section 26 05 00 - Common Work Results for Electrical.

- .2 Wall mounted in each main electrical room, in final location to be determined by the Consultant on-site.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
 - .1 Install rejection clips for Class R fuses.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.
- .5 Install spare fuses in fuse storage cabinet.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 24 02 – DISTRIBUTION PANELS.
- .2 Section 26 28 16.01 – PANELBOARDS BREAKER TYPE.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA-C22.2 No. 5, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMJ-J-266-ANCE).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include time-current characteristic curves for breakers with ampacity of 30A and over.

PART 2 PRODUCTS

2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers with interchangeable trips if applicable.
- .6 Circuit breakers to have symmetrical rms interrupting capacity rating the same as the panel as indicated on the Single Line Diagram.

2.2 THERMAL MAGNETIC BREAKERS DESIGN A

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 MAGNETIC BREAKERS DESIGN B

- .1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.4 CURRENT LIMITING AND SERIES RATED THERMAL MAGNETIC BREAKERS DESIGN C

- .1 Thermal magnetic breakers with current limiters.
 - .1 Time current limiting characteristics of fuses limiters coordinated with time current tripping characteristics of circuit breaker.
 - .2 Co-ordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker.
- .2 Series rated breakers to be manufacturer tested and listed. Breakers to be applied following manufacturer's guidelines and accepted best practice.
 - .1 Breakers applied following manufacturer's guidelines and accepted best practice.

2.5 SOLID STATE TRIP BREAKERS

- .1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time and instantaneous tripping for phase and/or ground fault short circuit protection.

2.6 OPTIONAL FEATURES

- .1 Include where necessary to meet design intent indicated on the drawings:
 - .1 Shunt trip.
 - .2 Shunt close
 - .3 Auxiliary switch.
 - .4 Motor-operated mechanism c/w time delay unit.
 - .5 Under-voltage release.
 - .6 On-off locking device.
 - .7 Handle mechanism.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install circuit breakers in appropriate location to suit equipment type as indicated.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2 No.144, Ground Fault Circuit Interrupters.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA PG 2.2, Application Guide for Ground Fault Protection Devices for Equipment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data and shop drawings.
- .3 Submit test report for field testing of ground fault equipment to Consultant and a certificate that system as installed meets criteria specified herein.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA-C22.2 No.144
- .2 Components comprising ground fault protective system to be of same manufacturer.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

- .1 Single, Two or Three pole ground fault circuit interrupter as shown on panel schedules and single line drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Do not ground neutral on load side of ground fault relay.
- .2 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results – Electrical and co-ordinate with Section 01 45 00 - Quality Control if required.
- .2 Arrange for field testing of ground fault equipment by Contractor before commissioning service.
- .3 Demonstrate simulated ground fault tests to Consultant.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2 No.4, Enclosed Switches.
 - .2 CSA C22.2 No.39, Fuseholder Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal of packaging material or for recycling in accordance with Waste Management Plan.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure one, to CAN/CSA C22.2 No.4, size as indicated and as required.
- .2 Provision for padlocking in on-off switch position by three locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated and/or as required to suit manufacturer supplied equipment, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.
- .5 Fuseholders: to CSA C22.2 No.39 suitable without adaptors, for type and size of fuse required.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.
- .8 Provide auxiliary contact for elevator disconnects as noted on plans.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification to suit Owner labelling requirements in accordance with Section 26 05 00 - Common Work Results – Electrical.

- .2 Indicate name of load controlled on size 4 nameplate.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.
- .2 Ensure all disconnect switches are installed in locations acceptable for operation from standing position without need for ladder, etc. and include 1 meter of clearance in accordance with OESC and ESA inspector requirements, confirm with inspector prior to rough-in as necessary.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 91 13.13 – Commissioning Plan.
- .2 Section 26 05 00 – Common Work Results Electrical.
- .3 Section 26 05 21 – Wires and Cables (0-1000V)

1.2 REFERENCES

- .1 International Electrotechnical Commission (IEC)
 - .1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide shop drawings for each type of starter to indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure types.
 - .5 Wiring diagram for each type of starter
 - .6 Interconnection diagrams.
 - .7 Elementary wiring diagrams shall include all power and control components packaged within the AC drive controller unit and documentation of any non-default settings programmed at the MCC factory.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.
- .3 Extra Materials:
 - .1 Provide listed spare parts for each different size and type of starter.
 - .1 3 contacts, stationary.
 - .2 3 contacts, movable.
 - .3 1 contacts, auxiliary.
 - .4 1 control transformer of each size.
 - .5 1 operating coil.
 - .6 2 fuses of each size.
 - .7 4 of each indicating lamp bulb type used.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.

PART 2 PRODUCTS

2.1 MANUFACTURER

- .1 Motor starters shall be based on supply from one (1) manufacturer where indicated on the drawings or Section 26 60 00 Powered Equipment Schedule where indicated as by "Electrical Contractor".
- .2 Motor starters shall be supplied by others where indicated in Section 26 60 00 Powered Equipment Schedule as by "Equipment Vendor" or "Mechanical Contractor".
- .3 Acceptable Manufacturers: All motor starters with features as necessary to suit Section 25 control requirements 25 by the following manufacturer's with final approval of accessories and features to be validated by Engineer during submittal review:
 - .1 Schneider Electric
 - .2 Eaton
 - .3 Allen-Bradley
 - .4 Siemens
 - .5 ABB
 - .6 Franklin Electric

2.2 MATERIALS

- .1 Starters: to IEC 947-4 with AC4 utilization category.
- .2 Half size starters not acceptable.

2.3 MANUAL MOTOR STARTERS

- .1 Single or Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
 - .1 Switching mechanism, quick make and break.
- .2 One or Three overload heaters, manual reset, trip indicating handle.
 - .1 Accessories:
 - .1 Toggle switch: heavy duty, oil tight, labeled as indicated.
 - .2 Indicating light: heavy duty, oil tight, type and colour as indicated.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.4 FULL VOLTAGE MAGNETIC STARTERS

- .1 Single or Three phase Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .3 Wiring and schematic diagram inside starter enclosure in visible location.
 - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

- .5 Suitable NEMA enclosure for individual starters.
- .2 Combination type starters to include motor circuit interrupter with operating lever on outside of enclosure to control disconnect and provision for:
 - .1 Locking in "OFF" position with up to 3 padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
 - .1 Selector switches: heavy duty, oil tight labelled as indicated.
 - .2 Indicating lights: standard type, GREEN for ON and RED for OFF.
 - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.5 VARIABLE FREQUENCY DRIVES

- .1 The AC drive controller unit shall be a combination disconnect-drive MCC style unit or loose mounted unit complete with suitable NEMA enclosure as indicated on the drawings. The integral input fusible switch shall provide OESC required branch circuit protection. The fusible switch shall have an external operator.
- .2 Units should be of modular construction so that it is possible to readily interchange units of the same size without modifications to the MCC structure.
- .3 All conducting parts on the line side of the unit disconnect shall be isolated to prevent accidental contact with those parts.
- .4 AC drive controller units up to 50 hp variable torque shall be plug-on units which connect to the vertical bus through a spring-reinforced stab-on connector. Units larger than 50 hp variable torque shall be connected directly to the main horizontal bus with appropriately sized cable or riser bus.
- .5 Provisions shall be provided for locking all disconnects in the off position with up to three padlocks.
- .6 All AC drive controller units shall be provided with unit control terminal blocks for use in terminating field wiring. Terminal blocks shall be pull-apart type, 250 V, and rated for 10 amperes. All current-carrying parts shall be tin-plated. Terminals shall be accessible from inside the unit when the unit door is opened. The stationary portion of the terminal block shall be used for factory connections and will remain attached to the unit when the portion used for field connections is removed. The terminals used for field connections shall be accessible so they can be wired without removing the unit or any of its components.
- .7 It shall be possible to read the drive information and command the drive through a door mounted, remote graphical interface.
- .8 Drive shall provide a sufficient number of input and output contacts, either 4-20mA or 0-10VDC to operate as specified in Section 25.

2.6 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

2.7 ACCESSORIES

- .1 Pushbutton: heavy duty, oil tight as required.
- .2 Selector switches: heavy duty, oil tight as required.
- .3 Indicating lights: heavy duty, oil tight, type and colour as indicated.

2.8 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.9 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire starters and controls as indicated.
- .3 Ensure correct fuses installed.
- .4 Confirm motor nameplate and adjust overload device to suit.
- .5 Coordinate all programming of motor starters directly with Section 22/23 to suit specific load requirements and all controls with Section 25.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 CLEANING

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

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

- .1 Provide complete factory assembled generator set equipment with digital electronic controls.
- .2 Provide factory test, startup by a supplier authorized by the manufacturer, and on-site testing of the system.
- .3 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 REFERENCES

- .1 The generator set and its installation and on-site testing shall conform to the requirements of the following codes and standards:
 - .1 CSA C282-15, 2015 Emergency Electrical Power Supply for Buildings
 - .2 IEC8528 Part 4. Control Systems for Generator Sets
 - .3 IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
 - .4 UL2200-20. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.
- .2 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.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Within 10 days after award of contract, 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 Manufacturer's certification of prototype testing.
 - .3 Manufacturer's published warranty documents.
 - .4 Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
 - .5 Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.
 - .6 Manufacturer's installation instructions.

1.4 FACTORY TESTING

- .1 Equipment supplied shall be fully tested at the factory for function and performance. The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory for a minimum of 4 hours. A certified test report shall be provided.

- .2 Factory testing may be witnessed by the owner and consulting engineer. Costs for travel expenses would be the responsibility of the owner and consulting engineer. Supplier is responsible to provide two weeks 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.

1.5 INSTALLATION

- .1 Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable 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 existing concrete slab. 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.

1.6 ON-SITE ACCEPTANCE TEST

- .1 The complete installation shall be tested under full load for a minimum 4 Hours to CSA C282-19 standards for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer. The Engineer/Owner shall be notified at least 2 weeks in advance and shall have the option to witness the tests. The contractor shall supply the load bank for the test period and re-connect the building once the test has been completed.

1.7 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 2 hours in duration. Training date shall be coordinated with the facility owner.

1.8 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.

1.9 WARRANTY

- .1 The generator set and associated equipment shall be warranted for a period of not less than 2 years from the date of commissioning against defects in materials and workmanship.

PART 2 PRODUCTS

2.1 GENERATOR SET

- .1 Ratings
 - .1 The generator set shall operate at 1800 rpm and at a voltage of: 600V/347VY Volts AC, three phase, four-wire, 60 hertz and manufactured in accordance with CSA C282-19.
 - .2 The generator set shall be rated at 250 kW, 312.5 kVA at 0.8 PF, standby rating, based on site conditions of ambient temperatures up to 40 degrees C.
 - .3 The generator set rating shall be based on standby service conforming to CSA C282-19.
- .2 Performance
 - .1 Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load for both parallel and non-parallel applications. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
 - .2 Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.
 - .3 The engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable de-rating factors, with the engine-generator set at operating temperature.
 - .4 The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic. Telephone influence factor shall be less than 50.
- .3 Construction
 - .1 The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.
 - .2 All switches, lamps, and meters in the control system shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.
- .4 Connections
 - .1 The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
 - .2 Power connections to auxiliary devices shall be made at the devices, with required protection located at a common distribution panel.
 - .3 Generator set control interfaces to other system components shall be made on a common, permanently labeled terminal block assembly.

2.2 ENGINE AND ENGINE EQUIPMENT

- .1 The engine shall be 4 cycle, natural-gas, turbo-charged, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Engine accessories and features shall include:

- .1 An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous or parallel states.
- .2 Skid-mounted radiator and cooling system rated for full load operation in 122 degrees F (50 degrees C) ambient as measured at the generator air inlet, based on 0.75 in H₂O external static head. Radiator shall be sized based on a core temperature which is 20F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The cooling system shall be filled with a 50/50-ethylene glycol/water mixture by the equipment manufacturer. Rotating parts shall be guarded against accidental contact.
- .3 Electric starter(s) capable of three complete cranking cycles without overheating.
- .4 Positive displacement, mechanical, full pressure, lubrication oil pump.
- .5 Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.
- .6 Replaceable dry element air cleaner with restriction indicator.
- .7 Flexible supply fuel line.
- .8 Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.
- .9 Coolant Heater
 - .1 Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.
 - .2 The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall be installed using quick disconnect couplers to isolate the heater for replacement of the heater element. The quick disconnect /automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.
 - .3 The coolant heater shall be provided with a thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.
 - .4 The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 100F (40C) in a 40F ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification.
 - .5 Provide coolant catch cans for expansion and compression of coolant due to weather.
- .10 Provide vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer.
- .11 Starting and Control Batteries shall be calcium/lead acid type, 12 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors.
- .12 Provide a weather rated sound enclosure to reduce sound pressure to 75 dBA @ 7 meters, and stainless steel exhaust flex connector for engine of size and type as recommended by the generator set manufacturer. Exhaust system shall be installed according to the engine manufacturer's recommendations and applicable codes and standards.
- .13 A UL listed/CSA certified 5 amp voltage regulated battery charger shall be provided for each engine-generator set. The charger may be located in an automatic transfer switch, or

may be wall mounted, at the discretion of the installer. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual indication of:

- .1 Loss of AC power - red light
- .2 Low battery voltage - red light
- .3 High battery voltage - red light
- .4 Power ON - green light
- .5 Charger shall include a DC voltmeter and ammeter, 12 hour equalize charge timer, and AC and DC fuses

2.3 AC GENERATOR

- .1 The AC generator shall be; synchronous, four pole, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees Centigrade.
- .2 The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.
- .3 A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.
- .4 The subtransient reactance of the alternator shall not exceed 12 percent, based on the standby rating of the generator set.

2.4 GENERATOR SET CONTROL

- .1 The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.
- .2 The control shall be mounted on the generator set. The control shall be vibration isolated, and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.
- .3 The generator set mounted control shall include the following features and functions:
 - .1 Control Switches
 - .1 Mode Select Switch. The mode select switch shall initiate the following control modes. When in the RUN or Manual position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - .2 EMERGENCY STOP switch. Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
 - .3 RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.

- .2 Generator Set AC Output Metering
The generator set shall be provided with a metering set including the following features and functions:
 - .1 Analog or digital voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Ammeter and KW meter scales shall be colour coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red.
 - .2 Metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.
- .3 Generator Set Alarm and Status Display
 - .1 The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing warning and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting and sunlight conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on an alphanumeric digital display panel in accordance with CSA-C282 and indicated below:
 - .1 low oil pressure (alarm)
 - .2 low oil pressure (shutdown)
 - .3 oil pressure sender failure (alarm)
 - .4 low coolant temperature (alarm)
 - .5 high coolant temperature (alarm)
 - .6 high coolant temperature (shutdown)
 - .7 engine temperature sender failure (alarm)
 - .8 low coolant level (alarm or shutdown--selectable)
 - .9 fail to crank (shutdown)
 - .10 fail to start/overcrank (shutdown)
 - .11 overspeed (shutdown)
 - .12 low DC voltage (alarm)
 - .13 high DC voltage (alarm)
 - .14 weak battery (alarm)
 - .15 low fuel-pressure (alarm)
 - .16 high AC voltage (shutdown)
 - .17 low AC voltage (shutdown)
 - .18 under frequency (shutdown)
 - .19 over current (warning)
 - .20 over current (shutdown)
 - .21 short circuit (shutdown)
 - .22 over load (alarm)
 - .23 emergency stop (shutdown)
 - .24 control switch not in auto (alarm)
 - .25 automatic transfer switch in non-auto mode or bypass mode (alarm)
 - .26 main disconnect/ overcurrent device open
- .4 Engine Status Monitoring
 - .1 The following information shall be available from a digital status panel on the generator set control:
 - .1 engine oil pressure (psi or kPA)

- .2 engine coolant temperature (degrees F or C)
 - .3 engine oil temperature (degrees F or C)
 - .4 engine speed (rpm)
 - .5 number of hours of operation (hours)
 - .6 number of start attempts
 - .7 battery voltage (DC volts)
- .2 The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.
- .5 Engine Control Functions
 - .1 The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
 - .2 The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
 - .3 The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.
 - .4 The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
 - .5 The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.
- .6 Alternator Control Functions
 - .1 The generator set shall include an automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from miss-operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of 58-59 HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
 - .2 Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445
 - .3 Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the

alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

- .4 An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

- .5 A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a "weak battery" alarm shall be initiated.

- .7 The generator set shall be provided with a generator mounted main line 100% rated LSI electronic trip circuit breaker, sized at 400A frame with a trip plug. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

2.5 UNIT ENCLOSURE

- .1 Provide to CSA-282-19
- .2 Skin Tight Sound Attenuated Weather Protective Enclosure
- .3 Perforated Metal Interior Lining
- .4 Electric Heat with Thermostat Control
- .5 Lockable Access Doors
- .6 Enclosure to meet 75dBA @ 7M
- .7 Enclosure insulation to be at least R-22 throughout on average.
- .8 Generator neutral to be left floating at factory, grounding and neutral to be installed as per bulletin OESC bulletin 10-10-8 Figure B2.

2.6 STEEL MOUNTING BASE

- .1 Complete generating set mounted on structural steel base of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation and under operating conditions on suitable level surface.
- .2 Assembly fitted with vibration isolators
 - .1 Spring type isolators with adjustable side snubbers and adjustable for leveling.
- .3 Sound insulation pads for installation between isolators and concrete base.

2.7 FUEL SYSTEM

- .1 Rich burn natural gas fuel supply.
- .2 3.0 NPTF fuel supply line inlet.
- .3 Natural gas fuel supply pressure: 1.74 – 3.74 kPa
- .4 Fuel Consumption (Natural Gas): At 100% - 3059 CFH
- .5 Electronic Fuel pressure gauge and vent alarm.
- .6 Shut-off cock.
- .7 Fire valves on supply line.
- .8 Isolating valves on lines serving auxiliaries.
- .9 Low fuel pressure alarm for remote indication.
- .10 Stainless steel braided fuel lines, use CSA approved with CRN#.
- .11 Fire safety valve on supply line.

2.8 OPERATION

- .1 Automatic Transfer Master Control
 - .1 Inputs for monitoring of normal/backup source availability at ATS outputs.
 - .2 Outputs to ATS selective load disconnect control contacts for re-transfer back to normal with time delay to be programmed at local ATS unit.
- .2 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. (Initially set to 5 seconds)
 - .2 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.
- .3 System Selector Switches – Not applicable.

2.9 ADDITIONAL FEATURES

- .1 Provide LED pilot lamps with controlling equipment to function as follows:
 - .1 Generator Running - Green
 - .2 Operating in Normal/Utility Power Mode – Green
 - .3 Operating in Backup/Generator Power Mode – Green

2.10 MAINTENANCE MATERIALS

- .1 Provide the following spare parts shipped loose:
 - .1 2 spares of each type and rating of control fuses for all metering, control transformers, power supplies, etc.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Locate generating unit and install as indicated.
- .2 Install fuel supply system.
- .3 Complete wiring and interconnections as indicated.
- .4 Start generating set and test to ensure correct performance of components.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Notify Consultant 10 working days in advance of test date.
- .3 Demonstrate:
 - .1 Unit start, transfer to load, retransfer to normal power, unit shut down, on "Automatic" control.
 - .2 Unit start and shut down on "Manual" control
 - .3 Unit start and transfer on "Test" control.
 - .4 Unit start on "Engine start" control.
 - .5 Operation of manual bypass switch.
 - .6 Operation of automatic alarms and shut down devices.
 - .7 Operation of remote annunciator.
- .4 Run unit on load for minimum period of 4 hours to show load carrying ability, stability of voltage and frequency, and satisfactory performance of dampers in ventilating system to provide adequate engine cooling.
- .5 At end of test run, check battery voltage to demonstrate battery charger has returned battery to fully charged state.

3.3 CLEANING

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

3.4 START UP

- .1 Preparation: before starting unit, carry out thorough mechanical and electrical inspection of equipment, and perform following checks and adjustments:
 - .1 Disconnect battery cables from batteries to prevent accidental starting.

- .2 Turn engine several revolutions by means of hand-barring devices to ensure parts are free and there are no obstructions to its running.
- .3 Check engine/generator alignment readings to ensure they match readings attained at time of manufacture.
- .4 Check fluid levels and top up as necessary. Pre-lubricate engine and turbochargers as recommended by engine manufacturer. Install drip pan beneath engine.
- .5 Ensure cooling system antifreeze is effective to at least minus 40 degrees C.
- .6 Check belts for correct tension and adjust as necessary.
- .7 Check and grease all grease points.
- .8 Check and tighten properly nuts, bolts, etc.
- .9 Ensure safety guards are in place and properly secured.
- .10 Check linkages for damage and freedom of movement.
- .11 Check fuel supply system for leakage.
- .12 Ensure fuel supply and fuel injection systems are properly primed.
- .13 Check and tighten properly electrical connections.
- .14 Check starting battery electrolyte level specific gravity and for proper installation.
- .15 Check battery charger for proper operation and adjust as necessary.
- .16 Carry out generator winding insulation resistance test. If reading is unacceptable, carry out recognized drying procedure. Do not start unit until satisfactory reading has been achieved.
- .17 Check jacket coolant heater for proper operation.
- .18 Complete additional preparations deemed necessary.
- .2 Performance verification: on completion of start-up preparations, take following action:
 - .1 Have at hand, during initial start-up, means for choking off air supply to engine air induction manifold in event of engine run away or other emergency.
 - .2 Reconnect starting battery cables to starting battery.
 - .3 Start unit only in presence of Consultant and allow to warm up. Stop unit if abnormal conditions are encountered.
 - .4 Check for and correct leakage from exhaust system, fuel system, cooling system, and lubricating oil system.
 - .5 Adjust vibration isolators.
 - .6 Observe and ensure that lubricating oil pressure and coolant temperature are within limits and no harmful vibration or sounds are evident.
 - .7 Ensure voltage is within operating parameters and automatic voltage regulator is operating correctly.
 - .8 Ensure manual voltage control is operating correctly.
 - .9 Ensure frequency is within operating parameters and electronic governor is operating correctly.
 - .10 Check engine air ventilation system for proper operation.
 - .11 Check operation of engine-mounted protective sensing devices and adjust as necessary.
 - .12 Check phase sequence of normal power supply and ensure emergency power supply are in same sequence.
 - .13 Check operation of electronic controller protection, transfer, timing, metering, and annunciator functions and adjust as necessary.
 - .14 Check operation and calibration of analog metering and adjust as necessary.
 - .15 Apply electrical load, read the meters, and correlate these readings.
 - .16 Demonstrate:
 - .1 Unit start, transfer to load, retransfer to normal power, unit shutdown, on "automatic" control.
 - .2 Unit start, transfer to load, retransfer to normal power, unit shutdown, on "full load test" control. Unit start and shutdown, on "no load test" control.
 - .3 Unit cranking, start, and shutdown by means of engine-mounted key switch.
 - .4 Run unit on load for minimum period of 4 hours to show load-carrying capability, stability of voltage and frequency, and satisfactory performance of engine

- ventilating system to provide adequate cooling.
- .5 Data shall be observed and recorded every 15 minutes, until completion of the test period.

.17 Perform additional tests as required by Consultant to ensure unit is operating satisfactorily.

3.5 COMMISSIONING

- .1 Site commissioning and the cost for it will be provided under this vendor and carried by the installing contractor. The installation requirements are part of this specification package. Fuel for commissioning will be covered by the installing contractor.
- .2 Provide commissioning report included time delay settings, operational set points and adjustment ranges.

3.6 MAINTENANCE - CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and CSA-B139.

3.7 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 signaled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set, and indicate "fail to crank" shutdown.
 - .2 The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate "fail to start".
 - .3 The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed, and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.
- .4 On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous, synchronize, load share, load demand, or load govern state.
- .5 When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.
- .6 On completion of the time delay stop period, the generator set control shall switch off the excitation system and shall shut down.
 - .1 Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 01 91 13.13 – Commissioning Plan.
- .4 Section 26 05 00 - Common Work Results - Electrical.
- .5 Section 26 43 13 – Surge Protection Devices

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN3-C13, Instrument Transformers.
 - .2 CSA C22.2 No.178, Automatic Transfer Switches
 - .3 CSA C22.2 No.5, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

1.3 SYSTEM DESCRIPTION

- .1 Automatic load transfer equipment to:
 - .1 Monitor voltage on phases of normal and backup power supply inputs.
 - .2 **Backup Power ATS Units:**
 - .1 Normal Power Fail: Transfer load from normal supply to generator back up power when equipment reaches rated frequency and voltage pre-set adjustable limits, or within 10 seconds of loss of normal power whichever is less, all control by GEN-1.
 - .2 Normal Power Returned: Transfer load from back up power to normal power supply when normal power from the main switchboard is restored, all control by GEN-1.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .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 transfer to backup power and back to normal utility power to suit source availability.
 - .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 78 00 - Closeout Submittals.

- .2 Detailed instructions to permit effective operation, maintenance and repair.
- .3 Provide a certificate of compliance with CSA 22.2 No. 178 for the transfer switches furnished under this section. The certificate of compliance is not required if the manufacturer's published data submitted and approved reflect CSA C22.2 No. 178.
- .4 Technical data:
 - .1 Schematic and wiring diagrams of components, controls and relays.
 - .2 Illustrated parts lists with parts catalogue numbers.
 - .3 Certified copy of factory test results.
 - .4 Installation information
- .5 The final close-out drawings and submittals shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Instrument transformers: to CAN3-C13.
- .2 Moulded Case Circuit breakers: to C22.2 No. 5.
- .3 Enclosure: EEMAC1 (NEMA1) general purpose enclosure c/w sprinkler proof drip hood.
- .4 Enclosure Finish: ASA49 as indicated on the Drawings.
- .5 Ratings:
 - .1 The isolation automatic transfer switch shall have withstand, closing and interrupting ratings sufficient for the voltage and the available short circuit at the point of application as shown on the system drawings.
 - .2 The voltage rating of the transfer switch shall be no less than the system voltage rating. The continuous current rating of the transfer switch shall be no less than the maximum continuous current requirements of the system.
 - .3 The automatic transfer switch shall be 100% equipment rated for continuous duty.
 - .4 The automatic transfer switch shall be fully rated to protect all types of loads, inductive and resistive, from loss of continuity or power, without de-rating, either open or enclosed.
 - .5 All control devices (i.e. pilot devices, relays, and metering) must be manufactured to industrial standards. All relays supplied shall be furnished with self-cleaning contacts.

2.2 TRANSFER SWITCH

- .1 Transfer switches shall consist of completely enclosed contact assemblies and a separate control panel. The contact assemblies shall be operated by a non-fused motor operator or stored energy mechanism and will only be energized during a transfer operation, providing inherently double throw switching action.
- .2 Each transfer switch shall be positively interlocked both mechanically and electrically to prevent simultaneous closing of both sources during automatic or manual operation. Each transfer switch shall be capable of achieving a neutral position for systems maintenance purposes. A transfer switch position indicator shall be included on the face of the transfer mechanism to display the switch position.

- .3 Transfer switches shall be capable of being operated manually under full rated load conditions. Manual operation shall provide true quick-make, quick-break operation to prevent possible flashovers from switching the contacts slowly.
- .4 On transfer switches requiring a fourth pole for switching the neutral, the neutral shall be fully rated with equal withstand, closing and interrupting ratings to the power poles. The neutral pole contacts shall be of identical construction as, and operate simultaneously with, the main power contacts. Switched neutral poles, which are add-on or overlap or that are not capable of breaking full rated load current are not acceptable.
- .5 Main contacts shall be designed and type tested to withstand multiple fault currents and shall meet CSA 22.2 No. 178 and C22.2 No. 5.
- .6 Fusing included on utility side as necessary to meet WCR/IAC ratings as noted on the drawings.
- .7 Lever to operate switch manually when switch is isolated.
- .8 Solid neutral bar, isolated from equipment bond, sized to suit equipment rating.

2.3 CONTROLS

- .1 Microprocessor Based Logic Controller:
 - .1 The transfer switch shall be controlled by a microprocessor-based controller. The controller shall be hardened against potential problems from transients and surges. Operation of the transfer switch and monitoring of both sources shall be managed by the controller.
 - .2 The logic control panel shall control the operation of the transfer switch. All sensing and logic shall be controlled by an onboard microprocessor for maximum reliability and minimum maintenance. The logic controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the control panel to be disconnect from the transfer switch for routine maintenance.
 - .3 The microprocessor-based logic controller shall be door mounted and shall provide the operator with an overview of the transfer switch status, parameters, and diagnostic data. The controller shall be listed under CSA.
 - .4 The microprocessor-based controller shall include a graphical touch screen display, and shall be capable of displaying the following:
 - .1 Connected Source and Load voltages on all phases
 - .2 Connected Source and Load frequency
 - .3 Condition status – Under-voltage, under-frequency, etc...
 - .4 Real time clock for Time / Date stamp c/w battery backup
 - .5 Historical data
 - .6 Programming and set point information
 - .7 Timer countdown for each timer while functioning
 - .8 Help function for detailed description of displayed messages
 - .5 The microprocessor-based controller shall include MIMIC BUS on controller HMI indicating the following:
 - .1 Mimic Bus Diagram showing Availability status of NORMAL source
 - .2 Mimic Bus Diagram showing Availability status of BACKUP source
 - .3 Mimic Bus Diagram showing Connection status of NORMAL source.
 - .4 Mimic Bus Diagram showing Connection status of BACKUP source
 - .5 Mimic Bus Diagram showing Preferred status of NORMAL source
 - .6 Mimic Bus Diagram showing Preferred status of BACKUP source
 - .7 Mimic Bus Diagram showing Energized status of LOAD
 - .8 Automatic mode
 - .9 Off mode

- .10 Test mode
- .11 Program mode
- .12 Display Navigational indicators for Status, Source 1, Source 2, History, Time/Date and Set Points
- .13 The microprocessor-based controller shall contain the following features:
 - 1. Programming protection
 - 2. Set points shall be stored in Non-Volatile memory or by use of an external battery source to maintain operation during "dead" periods.
- .6 Shall be capable of communicating to monitor all set points and operational characteristics over the following network protocol:
 - .1 RS232 INCOM
 - .2 10 Base T Ethernet
 - .3 RS485 Modbus RTU
 - .4 USB
- .7 Historical Data Storage to include:
 - .1 NORMAL source Available time
 - .2 BACKUP source Available time
 - .3 NORMAL source Connected time
 - .4 BACKUP source Connected time
 - .5 LOAD Energized Time
 - .6 Number of Transfers
 - .7 Date, Time and Reason for Last Sixteen (16) transfers.
 - .8 The microprocessor-based controller shall contain voltage and frequency monitoring of Normal and backup power sources.
- .8 The microprocessor-based controller shall contain the following time delay features:
 - .1 A time delay shall be provided on transfer to BACKUP source, adjustable from 0 to 1800 seconds. TDNE – Time Delay Normal to Backup {Option 1}
 - .2 A time delay shall be provided to override a momentary power outage or voltage fluctuation, adjustable from 0 to 120 seconds. TDES – Time Delay engine Start.
 - .3 A time delay shall be provided on retransfer from BACKUP source to NORMAL source, adjustable from 0 to 1800 seconds. TDEN – Time Delay Backup to Normal.
 - .4 A time delay shall be provided for engine failure to start, fixed setting of 6 seconds. TDEF – Time Delay Engine Fail.
 - .5 All delays shall be field adjustable from the microprocessor-based controller without the use of special tools.
- .9 The microprocessor-based controller shall contain the following input/output contacts:
 - .1 Eight (8) Form C output contacts for operation as indicated on the drawings coordinated with GEN-1 control. The contacts shall be of silver alloy with gold flashing. The contacts shall be rated minimum of 2-Amp at 250-Vac and 2-Amp at 30-Vdc.
 - .2 Sixteen (16) programmable inputs for operation as indicated on the drawings coordinated with GEN-1 control panel.
 - .3 Two (2) Form C output contacts for GENERATOR START signal, programmed as Normally Closed (N/C) as input to GEN-1.
- .2 Selector switch -four position "Auto", "OFF", "Engine Start", "Test".
 - .1 Auto position - Normal operation of transfer switch to source power on failure of normal power supply; retransfers on return of normal voltage and once GEN-1 provides output as pre-transfer contact indicating generator units are in cool down mode.
 - .2 OFF position – This shuts down the switch and prevents normal transfer operation in the event of an outage, etc. to make safe equipment as necessary for maintenance, etc. ensuring it will not function.
 - .3 Engine start position – Not required, engine starting and control in GEN-1.

- .4 Test position - Normal power failure simulated. Transfer takes place to generator source power. Return switch to "Auto" to go back to normal power.
- .3 Control transformers: dry type with 120V secondary to isolate control circuits from:
 - .1 Normal power supply.
 - .2 Backup power supply.
- .4 Solid state electronic in-phase monitor or programmable time delay for neutral.

2.4 ACCESSORIES

- .1 Pilot lights to indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel.
- .2 Pilot light indication of transfer switch position and availability of normal/backup voltage sources.
- .3 Selectable 3-phase (ϕ) or 1-phase(ϕ) failure protection on normal supply.
- .4 Selectable 3-phase (ϕ) or 1-phase(ϕ) failure protection on backup supply.
- .5 A momentary test selector switch or pushbutton shall be provided to simulate normal source failure.
- .6 Engine start contacts.
- .7 Transfer motor disconnect intended for manual operation.
- .8 Selective load disconnect contacts added as necessary to allow transfer and re-transfer time delays.
- .9 Surge protection devices installed at factory or in field, type as indicated on the drawings supplied by Section 26 43 13.
- .10 Wiring/Terminations:
 - .1 Terminal blocks shall conform to NEMA ICS 4. Terminal blocks for remote connections shall be arranged to facilitate the entrance of external conductors from the top or bottom of the enclosure. The main transfer switch terminals shall be suitable for the termination of conductors shown on the plans.

2.5 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Control panel:
 - .1 For selector switch and manual switch: size 4 nameplates.
 - .2 For meters, indicating lights, minor controls: size 2 nameplates.
 - .3 Nameplates to include: label as indicated on plans.

2.6 SOURCE QUALITY CONTROL

- .1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested.

- .2 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of CSA and EEMAC standards.
- .3 Tests:
 - .1 Insulation check to ensure the integrity of insulation and continuity of the entire system.
 - .2 Visual inspection to ensure that the switch matches the specification requirements and to verify that the fit and finish meet quality standards.
 - .3 Operate equipment both mechanically and electrically to ensure proper performance and free of mechanical hindrances.
 - .4 Check selector switch, in modes of operation Auto, OFF, Engine Start, Test and record results.
 - .5 Perform electrical tests to verify the complete electrical operation of the switch and to set up time delays and voltage sensing settings of the logic.
 - .6 Check:
 - .1 Automatic transfer of load on failure of normal power.
 - .2 Retransfer of load when normal power supply resumed.
 - .3 Automatic shutdown.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Locate, install and connect transfer equipment.
 - .1 The contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.
 - .2 All necessary hardware to secure the assembly in place shall be provided by the contractor.
 - .3 The equipment shall be installed and checked in accordance with the manufacturer's recommendations.
- .2 Check micrologic controller, solid state monitors, time delays, etc. 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 - Common Work Results - Electrical.
- .2 Energize transfer equipment from normal/backup power supply.
- .3 Set selector switch in "Test" position to ensure proper transfer AND retransfer. Return selector switch to "Auto" position to ensure system goes back to default utility power supply once backup power unit and transfer equipment shuts down.
- .4 Set selector switch in "OFF" position and check to ensure proper performance.
- .5 Set selector switch in "Auto" position and open normal power supply disconnect. Load should transfer to generator source power. Allow to operate for 10 min, then close main power supply disconnect. Load should transfer back to normal power supply.
- .6 Repeat, at 1h intervals, 2 times, complete test with selector switch in each position, for each test.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results for Electrical

1.2 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 Peak Current Testing)
 - .5 National Fire Protection Association (NFPA 70, 75 and 780)
 - .6 MIL Standard 220A Method of Insertion Loss Measurement
 - .7 National Electric Code
 - .8 Underwriters Laboratories UL 1283 and UL 1449 (3rd edition)
 - .9 Canadian Standards (cETL)

1.3 ENVIRONMENTAL REQUIREMENTS

- .1 The operating temperature range shall be -40° to 65° C (-40° to 149° F).
- .2 The unit shall be capable of operation up to 12,000 feet above sea level.
- .3 No appreciable magnetic fields shall be generated.

1.4 SUBMITTALS

- .1 Product Data: Provide catalog sheets showing voltage, physical size, IEEE Measured Limited Voltage for each waveform listed, UL 1449 latest revision, latest edition, voltage protection 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, including recessed or surface mounting enclosures where units are not integral to the equipment to suit type of panel, refer to drawings for details.
- .3 Manufacturer's Installation Instructions: Indicate application conditions and limitations of 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 UL 1449 latest edition, latest revision, and CSA approvals.

- .6 Provide actual Measured Limited 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 40 dB at 100 kHz.
- .8 Provide test report from a recognized independent testing laboratory verifying the suppressor components can survive published surge current rating on a per mode 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.

1.5 QUALITY ASSURANCE AND WARRANTY

- .1 The panel mounted SPD and supporting components shall be guaranteed by the manufacturer to be free of defects in material and workmanship for a minimum period of TEN (10) years from the date of substantial completion of service and activation of the system to which the suppressor is attached. Additionally, during the applicable warranty period, any SPD which fails due to any electrical anomaly, including lightning, shall be repaired or replaced by the manufacturer (or contractor responsible for this section if not honored by manufacturer) without charge to the Owner.
- .2 Since "Acts of Nature" or similar statements typically include the threat of lightning to which the SPDs shall be exposed, any such clause limiting warranty responsibility in the general conditions of this specification shall not apply to this particular section. That is, the warranty must specifically provide for unlimited free replacements of the SPD in the event of failure caused by the effects of lightning and all other electrical anomalies. The warranty shall cover the entire device as necessary, not just various components, such as modules only, to be replaced to make good as new.
- .3 Provide electrically operated equipment specified in this Section that is listed and labeled. As defined in the National Electrical Code, Article 100, Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- .4 Comply with NFPA 70.

1.6 MANUFACTURER QUALIFICATIONS

- .1 The SPD's shall be manufactured by "Innosys Power Inc." or an alternate manufacturer as noted in 1.6.3 below that has been regularly engaged in the design, manufacturing and testing of SPD's of the types and ratings required for a period of not less than five years.
- .2 The manufacturer's test laboratory shall be certified under ETL's, UL's or other nationally recognized test lab's client Test Data Submittal Program to conduct testing in accordance with UL 1449 (3rd edition) (Standard for Safety for Transient Voltage Surge Suppressors) and UL 1283 (Standard for Safety for Electromagnetic Interference Filters) covering Transient Voltage Surge Suppression, duty cycle, Dielectric Voltage Withstand and Leakage Current Tests. In addition, the manufacturer's test laboratory shall be certified under a *nationally* recognized test laboratory's Client Test Data Submittal Program to conduct testing in accordance with the new UL classification Program for evaluation of transient voltage surge suppressors in accordance with a IEEE C62.41 1991, recommended practice on surge voltages in Low-voltage AC power circuits.
- .3 The following manufacturers products are approved in principle subject to confirmation during the project shop drawing review process, at which time the Consultant reserves the right to make any changes necessary and include additional options to suit design intent:

- .1 Eaton
- .2 Schneider

PART 2 PRODUCTS

2.1 GENERAL PERFORMANCE

- .1 The SPD shall be listed by ETL, UL, or other nationally recognized test laboratory to UL's 1283 and UL's 1449 standards (3rd 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, 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. In delta systems, line-to-ground-to-line protection is not acceptable where line-to-line is specified.
- .3 Obtain all major surge suppression devices through one source from a single manufacturer; where an alternate/equal manufacturer product is being utilized in lieu of base bid product; all data line, ATS switch, disconnect units, control circuits, etc. SPD's to be from base product manufacturer as indicated in Sections 2.3 & 2.4 below.
- .4 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 347 and 600V systems.
- .5 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.
- .6 The consultant has the right to accept as an "approved equal" if the alternate proposed product meets the warranty, strength, safety features, IEEE Measured Limited Voltage (within limits acceptable to Consultant), modes of discrete suppression circuitry, fusing and all other requirements of this specification.
- .7 All integral mounted units installed in switchgear or MCC cubicles requiring an equipment power outage to replace are to include a disconnect switch to enable replacement without shutting down the equipment due to an SPD failure, etc., 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.

2.2 DISTRIBUTION PANEL, MOTOR CONTROL CENTRE AND SUB-PANEL / LIGHTING PANEL PROTECTION

- .1 The SPD for these locations shall be as indicated on project drawings, refer to single line distribution diagram for standard of acceptance and rating.
- .2 SPD shall mount external to sub-power/lighting panels or directly to enclosure or in cubicles within large distribution panels (coordinated with factory as required to validate branch breaker positions to suit physical mounting location of external SPD on-site) for shortest possible conductor lead connection.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install the SPD's direct to the bus or with the conductors as short and straight as practically possible; SPD supply vendor to provide inspection to ensure installation is acceptable.
- .2 Follow the SPD manufacturer's recommended installation practice as outlined in the equipment installation manual. The electrical contractor shall ensure that all neutral conductors are bonded to the system ground at the service entrance or the serving isolation transformer prior to installation of the associated SPD.
- .3 Main service entrance SPDs shall be installed on 60 to 100 amp dedicated breakers, or, where indicated, shall be installed on a fused disconnect switch provided by Total Protection Solutions, or other manufacturer, that meets or exceeds the fault current rating of the switchgear.
- .4 Distribution panel and motor control center units shall be installed on 60 amp dedicated circuit breakers, or, where indicated, shall be wired directly to the main lugs or feed through lugs, or wired directly to the bus bars.
- .5 Branch panel units shall be installed on 30 amp dedicated circuit breakers, or, where indicated, shall be wired directly to the main lugs or feed through lugs, or connected/wired directly to the bus bars.
- .6 The installing contractor shall comply with all applicable codes.
- .7 SPD manufacturer shall include in tender for pre-installation visit to the job site to confirm recommended installation methods. Indicate provision for this visit on shop drawing submission.
- .8 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.
- .9 Contractor will ensure the dry relay contacts on the inside of Service Track cover are connected to alarm system to indicate when replacement is required.

3.2 FIELD QUALITY CONTROL

- .1 Conduct tests in accordance with Section 26 05 00 - Common Work Results - Electrical and in accordance with manufacturer's recommendations.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results Electrical
- .2 Section 26 05 22 – Connectors and Terminations
- .3 Section 26 05 29 – Hangars and Supports
- .4 Section 26 05 32 – Conduits and Fittings

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
 - .2 ANSI C82.4, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps Multi Supply Type.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 ASTM International Inc.
 - .1 ASTM F 1137-[00(2006)], Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 Canadian Standards Association (CSA International)
- .5 ICES-005, Radio Frequency Lighting Devices.
- .6 Underwriters' Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Consultant.
- .3 Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

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

- .2 Deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
- .3 Packaging Waste Management: remove for reuse and return if applicable of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.
- .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.

PART 2 PRODUCTS

2.1 LAMPS

- .1 Supply luminaires complete with compatible lamps and ballasts/drivers as detailed and shown on the drawings using approved equipment as required by the lamp manufacturer.
- .2 Integral LED lamps and sources to be as specified or the LED drivers supplied with Consultant approved luminaires.

2.2 DRIVERS

- .1 LED driver, electronic 0-10V dimmable:
 - .1 Rating: voltage as indicated, for use with fixtures as indicated on plans.
 - .2 Power factor: minimum 90% with 95% of rated lamp lumens.
 - .3 Type: solid state.
 - .4 Input voltage range: plus or minus 10% of nominal.
 - .5 Temperature operation: Instant hot and cold (re)start,
 - .6 for use down to -30 celsius for all exterior fixtures.
 - .7 Sound rated: Class A.
 - .8 Mounting: integral with luminaire or remote where noted.

2.3 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.4 OPTICAL CONTROL DEVICES

- .1 As indicated in luminaire section of electrical equipment schedule, or provide fixture approved as an equal in writing by the consultant.
- .2 All acrylic diffusers to be tested in conformance with CAN/ULC-S102-M.

2.5 LUMINAIRES

- .1 As indicated on the drawings, or fixture provided and approved as an equal/alternate in writing by the Consultant and issued by Addendum prior to tender closing date.

- .2 All proposed product equal/alternates if not listed in the electrical equipment schedule on DWG e0.0 and must meet design intent for light source, quality and visual appearance to suit aesthetic design intent.
- .3 All alternate/equal requests to be submitted in writing for approval by the design professional a minimum of fourteen (14) calendar days prior to the tender closing date and must be made available to all bidders.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.

3.2 WIRING

- .1 Connect luminaires to lighting circuits:
 - .1 Install flexible or rigid conduit for luminaires as indicated.

3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires independently of ceiling.

3.4 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results - Electrical.
- .2 Section 26 05 21 - Wires and Cables 0-1000 V
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings
- .4 Section 26 09 43 – Networked Lighting Control System

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Data to indicate system components, mounting method, enclosure type, rating, source of power and special attachments.
- .3 Include:
 - .1 Battery charge and discharge voltage/time characteristics.

1.4 WARRANTY

- .1 Standard 10 year manufacturer's warranty on all batteries.

PART 2 PRODUCTS

2.1 UNIT EQUIPMENT

- .1 Emergency lighting unit equipment: to CSA C22.2 No.141.
- .2 Refer to Electrical Equipment Schedule on plans for standard of acceptance.
- .3 Approved emergency lighting manufacturers required to meet or exceed the product specifications as indicated on the drawings are as follows:
 - .1 ABB (Lumacell, Emergi-lite, Ready-Lite), Cooper(Sure-Lite), Stanpro, Beghelli.

2.2 WIRING OF REMOTE DC HEADS

- .1 Conduit: type EMT in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: type and size in accordance with Section 26 05 21 - Wires and Cables 0-1000 V, sized to suit Contractor planned installation method in accordance with manufacturer's recommendations.

2.3 WIRING OF BUILDING EMERGENCY FIXTURES

- .1 Conduit: type EMT in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: type and size in accordance with Section 26 05 21 - Wires and Cables 0-1000 V to suit contractor planned installation method.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install unit equipment and remote mounted fixtures in service spaces as indicated and install with conductors sized to maintain current flow with maximum 5% voltage drop.
- .2 Direct heads to suit proposed path of travel and egress from space to suit final equipment layout and configuration in the space. Adjust as necessary to suit requirements of AHJ.
- .3 Install all ULC approved emergency relay devices for control of all building emergency egress lights and associated wiring from control device to fixture (where identified as "emergency" on the plans) in accordance with all regulatory requirements.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results – Electrical and confirm all emergency egress lights fed from central inverter sources are operating as intended based on loss of normal utility power either locally or building wide, demonstrate to Consultant and AHJ as required.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results - Electrical.
- .2 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings
- .3 Section 26 05 21 - Wires and Cables 0-1000 V

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.
 - .2 CSA C860, Performance of Internally-Lighted Exit Signs.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

PART 2 PRODUCTS

2.1 STANDARD UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Refer to Electrical Equipment Schedule on plans for standard of acceptance.
- .3 Acceptable exit sign luminaire manufacturers required to meet product specifications on drawings are as follows:
 - .1 ABB (Lumacell, Emergi-lite, Ready-Lite), Cooper(Sure-Lite), Stanpro, Hubbell, Beghelli.

2.2 DESIGN

- .1 Recessed, wall, end to wall or ceiling mounted.
- .2 Single or Double face running man type as indicated on plans.
- .3 Arrow: right, left, straight from here as required.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Ensure that exit light circuit breaker is locked in on position.
- .5 Allow for supply and install up to five (5) additional exit signs c/w knockouts and configuration as necessary including all wiring, connections, conduit and terminations for use throughout the building as necessary to meet the requirements of the local building official's requirements.
- .6 Locate exit signs in visible locations above or beside exits, confirm with Consultant and local building inspection official prior to rough-in as necessary.
- .7 Install wire guards where indicated.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for concrete, steel, aluminum and wood lighting poles.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results - Electrical.
- .3 Section 26 50 00 - Lighting.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.206 - Lighting Poles.
 - .2 CAN/CSA-S6-06 (R2012) – Canadian Highway Bridge Design Code

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings for poles shall be signed and sealed by a Professional Engineer.

PART 2 PRODUCTS

2.1 STEEL POLES LANDSCAPING AND PARKING LOT LIGHTING

- .1 Steel poles: to CSA C22.2 No.206 designed for underground wiring and:
 - .1 Poles and anchor bolts shall be designed, fully loaded to withstand 90 mph wind loading (+1.3 gust factor).
 - .2 All steelwork shall conform with CSA Specifications CAN 3 G40.21M minimum grade 300W.
 - .3 Galvanize poles inside and outside in accordance with CSA G164 Table 1 and ASTM A123. Galvanized finish shall be have no bumps or runs.
 - .4 Poles and base plates shall be free of dents, pitting, corrosion, rust, and any sharp edges.
 - .5 All welding shall conform to CSA W59.
 - .6 All steel shall be hard stamped with trade mark and year of manufacture prior to galvanizing and painting (stamp must be visible after painting). Stamps shall be near base plates.
 - .7 Mounting to be on cast-in place concrete base.
 - .8 Style: monotube, straight round.
 - .9 Straight for one or two luminaire mounting brackets as indicated on the plans.
 - .10 Reinforced access hand hole 178mm x 102mm with cover assembly and stainless steel grounding stud complete with two nuts, welded inside the pole opposite the hand hole.
 - .11 Size: As noted.
 - .12 Anchor bolts: number and size as required c/w shims, nuts and covers to suit final approved lighting pole shop drawings.
 - .13 Finish: custom RAL finish to be selected by Architect during shop drawing approval.

2.2 LUMINAIRE MOUNTING BRACKETS

- .1 Mounting brackets for specified luminaires:
 - .1 Single and twin brackets as indicated for landscaping and parking lot lighting.
 - .2 Sports lighting fixture mounting brackets for tubular cross arms.
 - .3 Arm extension length: as noted on the drawings.
 - .4 Type: as required to suit luminaire.

2.3 LUMINAIRES

- .1 In accordance with Section 26 50 00.

2.4 FUSES

- .1 Tron Heb Series, 10A Buss KTK fuse, insulating boots.

PART 3 EXECUTION

3.1 CONDUIT & WIRING

- .1 Install conduit and in accordance with Section 26 05 00 and wiring in accordance with Section 26 05 21.
- .2 Bonding conductors are required in all conduits (which will not remain empty).
- .3 6mm nylon pull string shall be installed in all conduits which will remain empty of conductors.
- .4 Conduits shall be securely attached to rebar to prevent movement during placement of concrete.

3.2 INSTALLATION

- .1 Install concrete bases as indicated.
- .2 Install poles true and plumb as noted on the drawings, in accordance with manufacturer's instructions.
- .3 After the poles have been erected and plumbed and the anchor bolts tightened to approximately 200 Nm torque, bolts and nuts shall be completely covered with grease.
- .4 Nut covers shall be installed to cover the bolts and nuts.
- .5 Install in-line fuse holders and fuse at the base of each pole.
- .6 Install luminaire in accordance with Section 26 50 00 and connect luminaire to lighting circuit.
- .7 Check luminaire orientation, level and tilt.
- .8 Conductors for each circuit shall be neatly bundled together, coiled and held in place with ty-raps and tags at the base of each pole, in each junction box, in each hand hole, and any other access point where all conductors are accessible.
- .9 In each hand hole, junction box, and access point sufficient slack shall be left in conductors for ease of maintenance.

- .10 Conductor connections in junction boxes and hand holes shall be secured with solderless connectors.
- .11 Seal connections with self-holding tape covered with PVC tape. Dip conductors when installed in junction boxes.
- .12 In instances where more than two conductors are being spliced, each conductor shall be individually wrapped with minimum 6 wraps self-bonding tape, and sealed with minimum 6 wraps PVC tape
- .13 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical

3.3 RUST PROTECTION

- .1 All exposed metal accessories and hardware necessary for the installation shall be protected by galvanizing or corrosion resistant alloys.

3.4 INSPECTION AND TESTING

- .1 Municipal Electrical Inspector and the Site Engineer shall be notified 48 hours in advance of backfilling conduits, bases or junction boxes and testing of systems.

END OF SECTION

PART 1 GENERAL

1.1 POWERED EQUIPMENT SCHEDULE

- .1 The "Powered Equipment Schedule", lists all major powered equipment items supplied under other Divisions, and their associated electrical requirements, and is attached to this Section of the Specification.

1.2 USE OF THE SCHEDULES

- .1 Read this schedule, together with the drawings and other Sections of this Specification specific to each area of construction, in order to determine the scope of the Division 26 Electrical work required for the equipment supplied by other Divisions.

END OF SECTION

REFERENCE NOTES	Legend:		O: Owner	G: General Contractor	E:Electrical Contractor				M:Mechanical Contractor				C:Controls Contractor				F: Fused / U: Unfused									REMARKS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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